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SCIENTIFIC AMERICAN

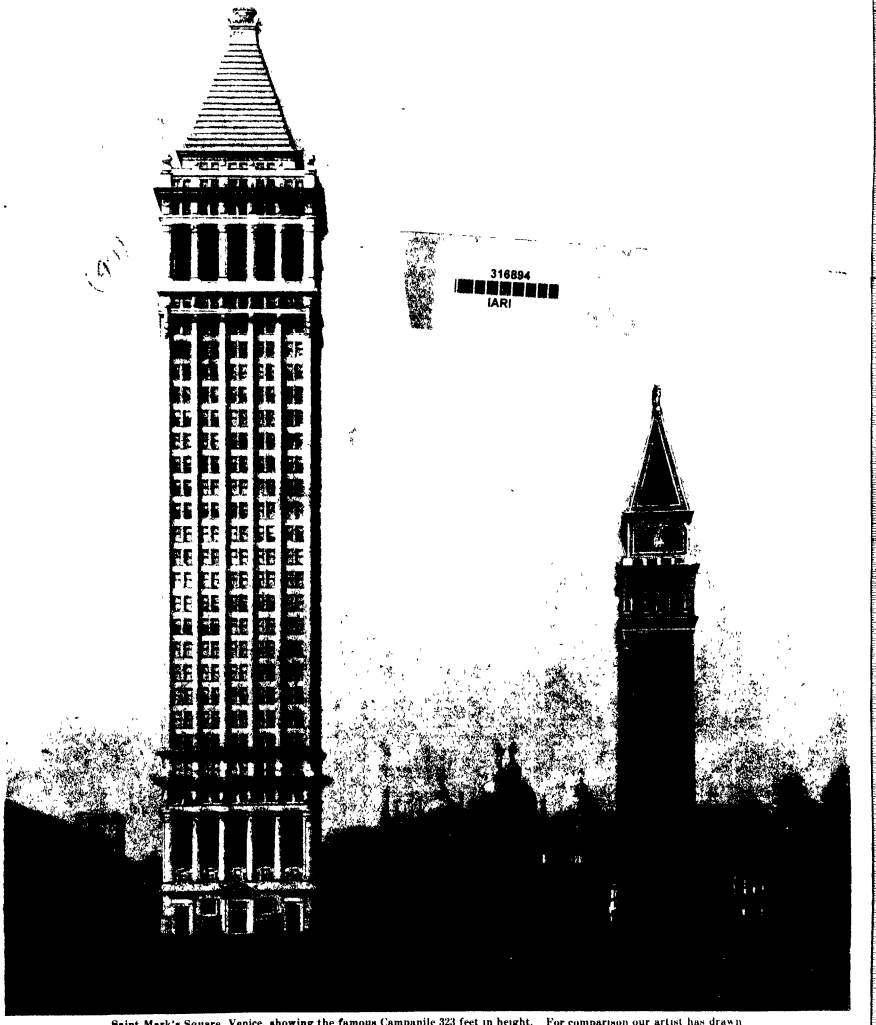
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Saint Mark's Square, Venice, showing the famous Campanile 323 feet in height. For comparison our artist has drawn upon the picture the Bankers' Trust Building which, upon a base 95 feet square, rises to a height of 510 feet.

CAMPANILES MEDIEVAL AND MODERN.—[See page 6.]

SCIENTIFIC AMERICAN

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The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are worth the article alone and the facts authentic, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

The purpose of this journal is to record accurately and in simple terms, the world's progress in scientific knowledge and industrial achievement. It seeks to present this information in a form so readable and readily understood, as to set forth and emphasize the inherent charm and fascination of science.

The Utility of Beauty

EVIDENCES are not wanting of a growing appreciation of the fact that in those broad fields of human activity which are covered by the architect and the engineer, there is no necessary antagonism between the useful and the beautiful. Too long the idea has prevailed that whenever we depart from those forms and dimensions which are demanded by a strict consideration of prospective returns on the money invested, a more or less serious money loss will be involved. Now, although there may be some truth in this conviction, it is not altogether true. For the public taste has been educated to a point where it is beginning to be recognized that in the construction of municipal works and of the more monumental of our commercial buildings, their value is distinctly increased, even as to their revenue-earning capacity, in proportion as they are invested with true beauty and dignity.

Even at this early day in the movement toward the realization of the city beautiful, there are several notable instances of the recognition of the principle above referred to, and we draw attention to the fact that when the architects of the office building which forms the subject of our front-page engraving urged upon the syndicate who are financing the structure the advisability of setting the front walls of the building well back from the columns of the loggia near the top of the building and also proposed to run up the pyramidal roof in solid granite, free from windows, the committee in spite of the fact that much very valuable rentable floor space would be lost, were willing to make the sacrifice for the sake of the gain in architectural effect. The concession was made on the understanding and recognition of the fact that the modern building which possesses architectural beauty and dignity is preferred by prospective tenants to those bald and cheerless monstrosities whose architects seem to have taken a perforated packing case as their model.

Other and even more notable instances are the two magnificent terminal buildings of the Pennsylvania and the New York Central railroad companies. The early plans for the station building of the New York Central showed a 25-story office building, towering above the station proper. Nevertheless, upon further consideration, the company decided to forego the large financial profits which could have been secured from a building of this character, in favor of the more beautiful and dignified structure which will form the easterly entrance gate to their great railroad system.

So also, the Pennsylvania Railroad, in the same admirable spirit of regard for the architectural embellishment of New York city, chose to erect over their terminal a monumental classic structure barely exceeding it in height of façade, which is one of the most handsome buildings of its kind in the world. Here also had the company chosen to do so, they could have erected a princely revenue by erecting a towering building upon the site, 100 by 700 feet square, occupied by this station.

Mention should also be made of that exquisite architectural structure which forms the home of the New York *Herald*. Too hasty considerations of utility might have prompted the erection on this valuable site of a typical skyscraper; but we venture to believe that the appreciation of the motives which led to the construction of this modest but beautiful building must have gone far to offset any pecuniary loss due to its limited size.

A New Danger for the Airman

THE two terrible accidents which occurred the opening day of the great circuit aeroplane race from Paris to London and return have opened the eyes of the aviation world to an ever-threatening danger to those who navigate the air in present-day aeroplanes. The monoplanes of two competitors caught fire in the air and fell like flaming meteors to the ground. The unfortunate airmen, strapped in behind their burning gasoline tanks, were frightfully burned before they were killed by the fall.

These catastrophes have brought out afresh, and very forcibly, the constant danger from fire in the flimsy structure of sticks and cloth that constitutes the modern aeroplane. In the first case of a machine catching fire in flight, which happened in Germany more than a year ago, we pointed out the necessity of fire-proofing the burnable parts of these machines, or of making them entirely of metal, so that they would not be consumed in case of fire. The late John B. Moisant claimed to have designed and built, in France, the first all-metal monoplane nearly two years ago, and of late a number of machines have been built there and in America largely of metal construction; but the great majority of aeroplanes in actual use are constructed of wood and cloth. Only a few days before the double disaster in France, above mentioned, a new biplane caught fire at Mineola while in flight, the whole center section being burned out before the machine came to earth and the flames were extinguished. There are several ways in which an aeroplane can catch fire from the gasoline motor that propels it. If the carburetor is located near and over the exhaust and a slight leak occurs, the dripping gasoline can easily ignite and set fire to the carburetor, thus creating a sufficient flare-up to ignite the cloth and woodwork. Hamilton's machine was partially burned in this way during preparations for a flight in the West. In a monoplane such as the Blériot, where the sides of the body at the front are formed of sheet aluminium, and where an inclined partition separates the aviator from the motor, there is a chance that the machine itself will not catch fire immediately and that the aviator may be able to shut off the gasoline and let that in the carburetor burn itself out. As the gasoline tank is placed back of the inclined partition, there is a fair chance that the flame will not reach it, but, on the other hand, the aviator may not be aware of the fire until the machine bursts in flames and it is too late to avert disaster. Such was evidently the case with Landron, in the De Pishoff monoplane.

There is another way in which the carburetor can ignite, and in all probability the accident happened in this way in Landron's case. A weak mixture or an air leak in the inlet pipe will sometimes cause a back-fire through this pipe to the carburetor, and there is an even chance that the gasoline in the carburetor will thus become ignited. Since the carburetor was hidden away beneath the engine hood, the aviator was probably unaware of the fire until the flames came back in his face. The aeroplane was flying at the height of nearly 2,000 feet when it caught fire. From the huge sheet of flame that shot forth, there is little doubt but that the gasoline tank ignited soon after the carburetor.

From the foregoing it would seem that in a monoplane the gasoline tank should be carried in the body, back of the aviator, the fuel being forced to the carburetor under pressure. This arrangement would be similar to that used on some automobiles, where the tank is at the rear end of the car. There should also be a shut-off that can be quickly turned by the aviator in case of emergency. In a biplane, instead of being placed above the lower plane just back of the aviator, the tank should be located beneath this plane, or should be suspended between the outriggers well to the rear. There have been several instances in which a machine, when it plunged to the ground, has caught fire owing to the proximity of the gasoline tank to the motor and the fact that the engine was still running. In the smashing of the R. & E. P. monoplane, when it upset in making a turn in a wind of some 40 miles an hour, the body of the passenger, Lieut. Depuit, was charred beyond recognition owing to the debris catching fire instantly when the machine struck the ground.

It will be seen, from the various accidents here mentioned, that the danger of fire is an ever present one, and one that every precaution should be taken to abolish. Because of the wide experience had with the internal-combustion motor in automobiles, the action of a gasoline motor, and the accidents to which it is liable, are so well known as to render the loss of a single life from fire in the air quite inexcusable. Designers of aeroplanes should see to it in the future that there is no possible chance of their machines igniting while in flight.

Biology and Biography

PROBABLY no phenomenon within the range of natural science appeals to us with greater interest than that complex series of events and actions which we call life. For we ourselves are living beings, and those effects which we observe in other creatures in the dispassionate spirit of scientific inquiry, are known to us by direct experience also, and touch the innermost nature of our conscious being. Ordinarily, when we speak of human life, we mean that succession of mental experiences with which the biographer and the novelist are concerned —the "mind life" which begins anew with each individual—rather than the biological or "material life"—which is absolutely continuous from generation to generation. The "mind life" may seem to us so to transcend the mere biological phenomena accompanying it, that these in comparison appear insignificant. Yet it is well to remember that the two stand in the closest possible relation. It appears that there can be material life without consciousness, but so far as we know, there is no consciousness without material life. Unconscious states in life we know from our own normal experience of sleep, as well as from abnormal diseased conditions ranging from a passing swoon to a mortal coma. We know, too, that by reflex action we can perform, wholly or in part aside from conscious control, various motions of a useful character. It is possible that in low forms of organisms all actions are of this kind; there seems to be no warrant, for example, for supposing that the amœba is in any sense "conscious."

As has already been indicated, however, such consciousness as we know is not only invariably associated with material life, but its character, its "color," is inextricably bound up with the past and present conditions and physical experiences of the individual. Now these conditions may be said to depend on two classes of factors. On the one hand they are determined by the "external circumstances" under which the individual is placed; these vary from case to case in a somewhat haphazard manner. On the other hand the condition of the individual, as he wends his way through life, is determined also by the progressive biological changes which lead him from childhood through adolescence to maturity and old age. These changes proceed in a regular manner, following in all normal individuals a common law or order, and thus impressing a specific stamp upon human life, and ranging all individuals under one general type.

To each man in his turn, rich and poor alike, regardless of circumstances, are revealed the basic truths of life. The gain in wisdom, which comes with the years, is not a mere accumulation of knowledge acquired through the information carried to us from outside by our senses, but is rather a change in point of view, an evolution from within. The same event is seen in a different light by the young child, living in a world of naïve innocence, by the adolescent, when the blood runs hot and energy abounds, and by the veteran, in whom the lamp of life burns low. This is the romance of life, sung by the poet and represented in our best fiction. For, just as perfection of physical form, the expression of biological haleness, appeals to our æsthetic sense and elicits our homage, so the contemplation of its spiritual counterpart, the "perfect life," in which all human faculties are developed to their highest excellence and perform their functions uncurtailed and untrammeled, speaks to us with its own inspiration. Such perfection is, however, but an artist's ideal, rarely approached in real life. Indeed, the other extreme is perhaps more common, the crippled in body, though undaunted in spirit, who would fain—but cannot—join others in their toil and play; and the cripples in life, who through unheard circumstances is deprived of the opportunity to exercise his faculties to the full; condemned to drag out a colorless existence to the end of his days.

Between these two extremes the average human life is laid. Though each runs a similar thread, as our biological make-up is similar. But the details differ from case to case. To each of us in turn life's story is told. We listen, as to some old melody played with infinite variations, now in a minor key—rehearsing over the same theme, yet never twice the same; now listener, now singer, but ever, and with its last note the spell of life has expired.

Cross-Country Aeroplane Races in Europe

Further Particulars Regarding Recent Record-Breaking Flights

WHAT Vedrines had to fly over in his wonderful flight from Paris to Madrid is graphically shown in the photograph reproduced on this page, for which we are indebted to *The Car*. Flying low over the rugged peaks of the Pyrenees, Vedrines took chances such as only the most daring aviators would take.

Starting from San Sebastian at 7:20 A. M. on the morning of May 25th in a dense fog, Vedrines succeeded in crossing the Pyrenees and reaching Quentana-Pelta, a few miles from Burgos, where he was obliged to repair the damage to his tank and to get aid to place his machine on a suitable field for restarting. He then flew back to Burgos, where he passed the night and made a fresh start at 5 20 A. M the next morning. He covered the remaining 135 miles to Madrid without a stop in 2 hours and 46 minutes, alighting on the aerodrome at 8:06 A. M. amid the applause of thousands of spectators. His total time in flight for the 722 miles was 7 4 hours and 54 minutes, so that he covered the distance from Paris to Madrid at an average speed of 48¼ miles an hour. His total official time, including penalization, was 37 hours 27 minutes 12 1/5 seconds.

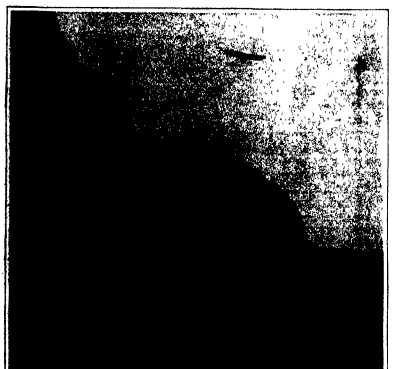
The other two survivors, Garros and Gibert, did not fare so well as Vedrines. The former got only 5 miles from San Sebastian when he was obliged to descend because of a motor mishap. He restarted and flew a few miles farther, when he came down at Andoain, where he broke his propeller and damaged his machine so that he was obliged to give up the race. Gibert, after crossing the Pyrenees, landed at Alsasua, near Vitoria, but in restarting his Blériot upset on account of the rough ground and was badly damaged. He made repairs, but was hindered from continuing the flight the next day on account of bad weather conditions.

One of our illustrations shows Vedrines on his Morane monoplane just after he alighted at Madrid. The flatness of the wings is very noticeable in this photograph, there being so slight a curvature that it is almost imperceptible. It is due to the flat wings in combination with the 70 horse-power Gnome motor that Vedrines is able to obtain a speed in straightaway flight of about 75 miles an hour. The specifications of his machine appear in the table on the following page. The supporting surface of the wings is 17½ square meters and the spread 9½, while the total length of the machine is 7 meters. The loading is about 6 1 pounds per square foot. Scale drawings of this machine were published in SUPPLEMENT No. 1851. It is one of the most advanced types of monoplanes thus far produced, and probably the fastest with a given horse-power when traveling in a straight line. One noticeable point is the curving of the front edge of the wings at their outer end instead of the rear edge, as with the Blériot. In the Paris-Rome-Turin race Vedrines did not have good luck. He started several days after the others and only got as far as Macon, where his machine was demolished in alighting and he abandoned the race. Gaget and Frey both drove Morane monoplanes with 50-horse-power Gnome motors. The former, when starting at Lasanna, ran into a dog and smashed his machine, which caused him to abandon the race; but Frey, after many mishaps and the substitution of a new machine, succeeded in reaching Rome third in 125 hours and 41 minutes. Count Zbrowski, on his Blériot, was first in 93 hours and 5 minutes, and Conneau second in 106 hours and 14 minutes. Frey was the only competitor who took part in practices in Paris. After making several starts and returning to the aerodrome, on account of bad weather, he at length came to grief in a storm and fell upon marshy land with great force, two arms and one leg being broken and the aviator being saved from instant death merely from the fact that he fell in a soft spot and that he wore a safety helmet. Vidart was the only other aviator in the race to reach Rome. He arrived on his Deperdussin monoplane several days after Conneau and Garros his time for the trip being 171 hours and 13 minutes. The prizes won by the four men who finally arrived at Rome were as follows: Lieut. Conneau, $21,800; Garros, $9000; Frey, $4600, and Vidart, $4000.

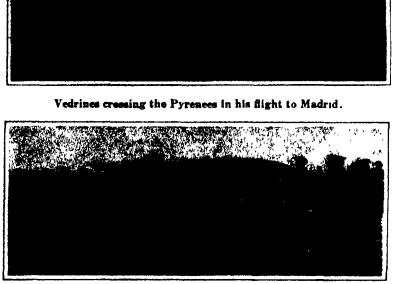
One of the new monoplanes that appeared in the Paris-Rome race was the Sommer, photographs of which are reproduced herewith. The three Sommer monoplanes in the race were flown by Kimmerling, Bathlat, and Molla. Kimmerling was delayed at Briguoles for several days. He finally received a new machine and got as far as Cabase (Var), where the machine capsized and was badly damaged. Bathlat got as far as Lyons, where he was obliged to abandon the race. He covered the 68 miles from Dijon to Macon in 54 minutes or at the rate of 75.9 miles an hour. The Sommer monoplanes seem to have met with bad luck and to have experienced considerable motor trouble. One of their pilots took along carrier pigeons with which to send back messages when he experienced breakdowns. Molla flew as far as Vienne, which was the greatest distance traversed by any of these machines. Bathlat's record between Dijon and Macon shows the Sommer monoplane to be a fast machine.

The first great circuit race, and the longest and most popular of all the big cross country flights scheduled in Europe this summer is that known as the European circuit which started from Vincennes on June 18th and includes a double crossing of the Channel with a turning point at London. Nearly $100,000 in prizes were put up, including $12,500 by the London *Standard* for the first machine to arrive at London. There were some sixty-five entries in all, but about fifteen of these cancelled, and when it came to the start of the race thirty-nine machines crossed the line. The first stage consisted of a flight of 212 miles to Liege, with an obligatory stop at Rheims on the way, the second stage was a round trip to Spa and return, a total distance of 37¼ miles, the third stage brought the flyers to Utrecht, 112¼ miles, the fourth to Brussels, 68¾ miles, the fifth to Roubaix, 56¼ miles, the sixth to Calais, 62½ miles, the seventh to London 93¾ miles. The return trip from Calais was made via Amiens, in a straight line to Vincennes, 136½ miles.

The start of the race was as systematic as is the start of a big automobile race. The machines started from three parallelograms at intervals of 2 or 3 minutes. After the gun sounded at 6 o'clock, Tabuteau, on a Bristol biplane, Vedrines on a Morane monoplane, and Bathlat on a Sommer monoplane, were off inside of 3 minutes. It is estimated that a quarter million people witnessed the start and cheered the aviators. Within 20 minutes Tetard, Kimmerling, Lieut. Conneau, Gaget, Garros, Molla, Vidart, Wynmalen, Morin, and Pedrini were on their way. They were soon followed by Biellovncci, Amerigo, Pascal Duval, Bobba, Count Dhesbel, Loridon, Contenes, Charlix, La Bouret, Le Lasseur, Prince De Nissole, Allard, Weymann, Barra, Gilbert, Valentine, Marquis de Romance, Landron, Morison, Bille, Le Martin, Verrep, Euhlind, Balger, and

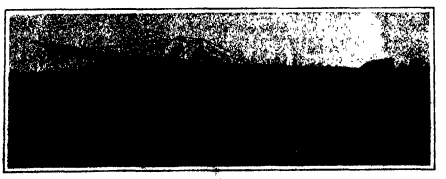


Vedrines crossing the Pyrenees in his flight to Madrid.

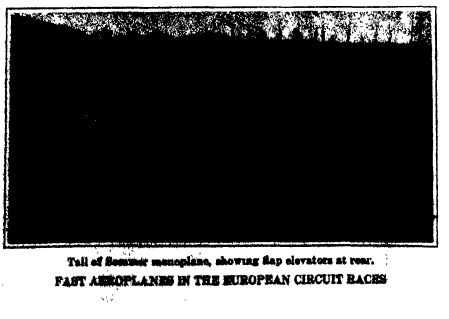


Vedrines' Morane monoplane after its arrival at Madrid.

Note the almost perfectly flat wings used on this fast machine.



Three-quarter rear view of Sommer monoplane.



Tail of Sommer monoplane, showing flap elevators at rear.

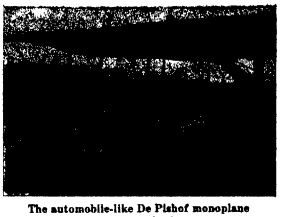
FAST AEROPLANES IN THE EUROPEAN CIRCUIT RACES

last of all, Emile Train, the aviator whose machine killed Mons Berteaux, the Minister of War, at the start of the Paris-Madrid race

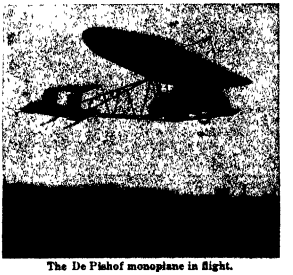
Besides the usual number of withdrawals owing to poor starts, the race was marred by three fatal accidents which occurred within a short distance of the aerodrome The nearest of these was the accident to Le Martin, who had had trouble with his rudder and had been advised by Garros not to start. He started twenty-sixth on the list, however, and no sooner was he in the air than it was seen that he had lost control of his machine, which bobbed up and down dangerously He had risen to about 200 feet and was straightening out on his way, when suddenly the machine began to pitch about in a terrifying manner just as he was passing over a patch of woods Le Martin shut off the motor and attempted to glide to the ground, but a gust of wind drove the machine to earth and upset it The aviator was pinned to the ground and his skull was terribly crushed He died a few minutes after he had been taken to the hospital

The other fatal accidents were much more spectacular The first of these happened to Capt Princetau, a young lieutenant who had just been gazetted the day of the race He had been ordered to accompany the racers and was flying at Issy-les-Moilneaux, at a height of some 75 feet, when suddenly his machine burst in flames and dove to the ground So hot was the fire that the captain's fellow officers were unable to get him out of the wreckage, and he was burned to death beneath it. If indeed he was not burned and rendered unconscious before the machine struck the ground

The second aviator to meet a similar fate was Landron, who flew a De Pishof monoplane He was flying above Chateau Thiery at an elevation of about two thousand feet, when his machine burst into flames and fatally burned the aviator during its drop to the ground We reproduce photographs of the De Pishof monoplane in flight and on the ground It



The automobile-like De Pishof monoplane viewed from the front.



The De Pishof monoplane in flight.

Garros in 5 hours and 3 minutes, and Renaux (the only contestant carrying a passenger) in 12 hours and 55 minutes After a rest of two days, during which time ten more of the aviators had arrived at Liege, 14 of them made the flight to Spa and return. On May 22nd the second real stage of 130 miles to Utrecht was flown Vedrines smashed two machines and was obliged to get a third. Seven aviators reached Utrecht in the following order: 1, Gilbert (Blériot); 2, Vidart (Deperdussin); 3, Garros (Blériot); 4, Lieut. Conneau (Blériot); 5, Weymann (Nieuport); 6, Kimmerling (Sommer); 7, Train (Train). All the aviators were bothered by a strong and gusty wind. Amerigo capelsed when ascending at Liege He was thrown out and seriously injured. Renaux and Le Lasseur both fell and the latter was rather badly injured. Duval descended near Venlo, and Barry broke down near Randwyk.

The third stage of the race, 93½ miles from Utrecht to Brussels, was flown on Friday, June 23rd, but no reports have been received of this stage up to the time of our going to press.

PARIS—ROME—TURIN.—Table of characteristics of entered machines.

Pilot and Machine	Supporting Area.	Weight Empty	Weight Flying	Span.	Length.	Balancing.	Under-carriage.	Suspension.	Control. Elevator	Control. Balance	Control. Rudder	Engine. Make.	Engine. h.p.	Engine. Cyls.	Engine. Bore.	Engine. Stroke	Propeller. Make.	Propeller. Diameter.	Propeller. Pitch.	Propeller. Blades.	Speed.	Speed. Flight.
	sq. ft.	lbs.	lbs.	ft. ins.	ft. ins.													ft. in.	ft. in.		r.p.m.	m.p.h.
Niemela (Nieuport)	196	750	1100	33 0	27 7	W	W & s	S	Pedal	Lever		Gnome	50	7	110	120	Integrale	8	7 5	5	2 1100	72
Bathiat (Sommer)	182	580	900	34 9	29 8	W	W & s	R	Lever	Bar		,,	50	7	110	120	Rapid	8	6 5	4	2 1100	59
Lemasson (Caudron)	235	550	880	26 4	26 4	W	W & s	R	,,	,,		Anzani	60	6	105	125	Normale	—	—	2	—	59
Vidart (Deperdussin)	150	495	825	29 8	23 0	W	W & s	R	Wheel	,,		Gnome	50	7	110	120	Rapid	8	3 5	4	2 1100	68
Molla (Sommer)	182	580	900	34 9	29 8	W	W & s	R	Lever	,,		,,	50	7	110	120	,,	8	3 5	4	2 1100	59
Beaumont (Blériot)	187	505	835	29 4	26 8	W	Wh	R	,,	,,		,,	50	7	110	120	Integrale	8	7 5	5	2 1100	59
Tetart (Bristol)	454	800	1100	34 9	38 7	F	W & s	R	,,	,,		,,	50	7	110	120	,,	9	3 5	4	2 1100	50
Bielovucic (Vosin)	1100	1590	1590	36 4	34 9	F	Wh	S	Bar	Wheel		,,	70	7	130	120	Vosin	8	7 6	7	2 1200	62
Lusetti (Morane)	187	440	770	30 7	22 1	W	W & s	R	Lever	Bar		,,	50	7	110	120	Integrale	9	3 5	4	2 1100	62
Kimmerling (Sommer)	182	580	900	34 9	29 8	W	W & s	R	,,	,,		,,	50	7	110	120	Rapid	8	6 5	4	2 1100	59
Landron (Autoplan)	288	790	1140	36 4	29 8	F	W & s	R	,,	,,		Labor	70	4	100	160	Integrale	9	10 6	7	2 900	50
Védrines (Morane)	187	790	1140	30 7	22 1	W	W & s	R	,,	,,		Gnome	50	7	110	120	,,	8	7 5	5	2 1100	62
X— (Ch. Joly) (Vosin)	450	1100	1540	36 4	34 9	F	Wh	S	Bar	Wheel		,,	50	7	110	120	Vosin	8	6 5	4	2 1100	50
Level (Savary)	555	1210	1540	46 0	32 9	F	W & s	R	Lever	Bar		Labor	70	4	100	160	Integrale	8	10 6	7	2 800	56
Gaget (Morane)	187	440	770	30 7	22 1	W	W & s	R	,,	,,		Gnome	50	7	110	120	,,	8	7 5	5	2 1100	68
Tabuteau (Bristol)	454	800	1100	34 9	38 7	F	W & s	R	,,	,,		,,	50	7	110	120	,,	9	3 5	4	2 1100	50
A. Frey (Morane)	187	440	770	30 7	22 1	W	W & s	R	,,	,,		,,	50	7	110	120	,,	8	7 5	5	2 1100	59
Garros (Blériot)	187	505	835	29 4	25 0	W	Wh	R	,,	,,		,,	50	7	110	120	,,	8	7 5	5	2 1100	59
Prince de Nisloie (Tellier)	256	680	1100	39 0	36 4	W	Wh	S	Wheel			R E.P	60	5	110	160	,,	—	—	2	—	46
Weymann (Nieuport)	196	750	1100	33 0	27 7	W	W & s	S	Pedal	Lever		Gnome	70	7	130	120	,,	8	10 6	7	2 1300	78
Manissero (Blériot)	187	505	835	29 4	25 2	W	Wh	R	Lever	Bar		,,	50	7	110	120	,,	8	7 5	5	2 1100	59

Notes —W = Warping. F = Flaps W & s = Wheels and skids. Wh = Wheels. R = Rubber. S = Springs.

Table by courtesy of *Flight*

will be seen that this machine differs materially from the usual type of monoplane It was fitted with a 70 horse-power, 4 cylinder Labor motor in place of the revolving cylinder Gnome which was used on Lieut Princetau's Blériot How these machines came to catch fire in flight, and the ever-present danger of such an occurrence, is discussed elsewhere in our columns

Besides the fatal accidents above mentioned there were several other accidents that were rather serious Lieut Gaubert fell near Soissons and was found lying unconscious in a wheat field Bielle fell within a mile of the start and was badly bruised and Loridan, Morison and Morin also made heavy landings and received a severe shaking up The last named was within twenty miles of Liege when he met disaster The aviators who reached Liege the same day were Vidart, in 3 hours 13 minutes; Vedrines, in 3 hours and 38 minutes, Weymann, on a Nieuport monoplane, in 4 hours and 55 minutes, Lieut Conneau, in 4 hours and 07 minutes; Barra, on a Farman biplane, in 4 hours and 8 minutes, Duval, on a Caudron biplane, in 4 hours and 31 minutes;



LEFEVRE MONOPLANE, SHOWING IMPROPER ARRANGEMENT OF GASOLINE TANK

Arrangement of Motors and Fuel Tanks on Aeroplanes

ON OUR editorial page we call attention to the danger from fire on present-day aeroplanes and make suggestions regarding the location of the gasoline tank in a safer position than one in proximity to the motor. The Gnome motor, which is so widely used on the modern machines, is in some cases surrounded by a steel ring or casing which keeps the oil from flying out by centrifugal force and coming back in the face of the aviator. A section of the ring is missing at the bottom part, for it is at this point that the exhaust valve of each cylinder is open and that the burning gases are allowed to escape into the air. As no carburetor is used in this motor, the gasoline being fed through a jet into the horizontal hollow stationary crankshaft, there is no danger of the machine catching fire from the carbureter in the way we have stated. In Lieut Princetau's case the machine is said to have burst into flames and to have set fire to the aviator's clothing while he was 75 feet in the air. It is difficult to explain how this happened. In all probability there was a gasoline leak near the motor, and the fuel, trickling down through the floor, caught fire from the burning exhaust gases as they shot out underneath the machine. The flames were driven back at the aviator by the speed of the aeroplane through the air, and no doubt the gasoline tank ignited the moment he struck the ground.

One of the illustrations on this page shows the Henri Lefevre monoplane (which is one of the newest French machines) fitted with an 8-cylinder V-type motor The radiators are shown on each side of the body and the gasoline tank above and slightly to the rear of the engine; the carburetor can be plainly seen between the cylinders at the front. This arrangement of the gasoline tank is a very dangerous one and one that should be avoided If by any chance the carburetor should catch fire, the flames would instantly strike the gasoline tank, melt any soldered joint in the piping or tank, and deluge the motor and machine with a flood of gasoline; the result would be a terrific conflagration and the aviator would have no chance of escape. There is also a possibility of an explosion in case the gasoline tank should happen to be only partially filled The arrangement of the tank on the Lefevre monoplane is therefore one that should be avoided.

Turf as a Filter

RECENT experiments in France have shown that natural turf is an excellent material from which to form beds for the filtering of sewage. A volume of between three and four cubic meters of sewage can be purified every day for every square meter of the surface of the turf. A turf filter that has been in use for some time shows no diminution of efficiency. If a larger proportion of sewage than that mentioned is employed the filter proves less effective, but it recovers its power when the amount of sewage is reduced to the proper proportion. Chemical analysis and the effects upon fish put into the filtered water unite in testifying to the efficiency of the process.

Air Consumed in One Minute

IN one minute, in a state of rest, the average man takes into his lungs about 8 liters or 488 cubic inches of air. In walking, he needs 16 liters or 976 cubic inches; in climbing, 32 liters or 1,952 cubic inches; in riding at a trot, 48 liters or 2,928 cubic inches; and in running for a short distance, running, 60 liters or 3,660 cubic inches.

One Hundred and Forty-four Postal Cards per Second

A New Machine for the Public Printer

By Thomas D. Gannaway

WHETHER the government ownership of certain public utilities would be an advantage to the mass of people, is a much mooted question. But Mr. Samuel Donnelly, Public Printer, is thoroughly demonstrating the fact that the government ownership of postal card presses is a case of real economy to the United States Government. Until the beginning of the present fiscal year, postal cards have been printed under annual contract by private concerns. This necessitated a great deal of unnecessary trouble and expense to the Government.

The Government Printery naturally must keep abreast with the rapid growth of the public business. It has, therefore, been enlarged from time to time, until it to-day is the largest printing establishment in the world.

Last year, when bids for the printing of postal cards for the next ensuing fiscal year were asked for, Mr. Donnelly, the Public Printer, wishing to serve "Uncle Sam"—his employer—to the best of his ability, submitted a bid for the job. The printing of the little one-cent postal cards for one year is a tremendous undertaking, and the making up of the bid requires very accurate figuring. It is claimed by the contractor of last year that he lost money. He would not bid for the job again, which is good evidence of the truth of his assertion. When the bids were opened by the department, it was found that the Public Printer was the lowest bidder. There was some criticism at the time on the Government's undertaking to do this work. This must have been due to the critic's lack of knowledge of the ability of the Government Printing Office to do the task. There is no private concern as well equipped to do this job, and do it as economically, as the Government. Again, a private firm, not having any assurance of getting their contract renewed, could not afford to invest in the proper machinery, which must, necessarily, be of a special design, to produce the best results. The private contractors, therefore, were compelled to use the ordinary straight sheet press; while, as may be seen from the accompanying cuts, the Government is using very large rotary presses especially designed for this work. It was thought, until within the last few months, that such work could not be done on the rotary style of press. The use of such press greatly increases the speed with which the cards can be printed, thereby diminishing the cost of them. The two rotary presses now in use have a capacity of over two million postal cards each in eight hours. It would be preposterous to think of an ordinary flat sheet press approaching half of this capacity.

The paper on which the cards are printed is wide enough to allow eight cards to be printed lengthwise across it. Each roll weighs one thousand pounds net. Ordinarily there is great waste in handling this size roll of paper, by hauling it on trucks, standing it on end, tumbling it about from place to place, and incidentally dropping it. In order to prevent this wastage, and at the same time save the expense of handling it so much, Mr. Donnelly conceived the idea of building a structural iron rack to hold the stock of postal card paper. As will be seen from Fig. 1, this rack consists of three tracks, one over the other. At either end of it is an overhead track, on which is mounted a portable lift.

A large ball-bearing truck, drawn by two horses, is used to haul the paper from the freight station. It carries six rolls, or seven hundred pounds gross weight, of a load. A load is pulled up to the entrance to the loading card department, where the overhead track referred to extends out over the driveway; then the portable lift is run out over the loaded truck, a piece of three-inch pipe is run through a roll of paper, the lift is hooked onto each end of the pipe, and, although the roll weighs eleven hundred pounds, one man hoists it up and runs the lift back to the end of the rack, where the roll of paper is swung around into place. Small two-wheel trucks are placed under each end of the three-inch pipe and on a monorail on each side of the rack, then pushed on to make room for the next one. This rack is two hundred and ten feet long and has a storage capacity of two hundred and eighty thousand pounds of paper at one time. When one deck of the rack is filled, a large cable which extends from the delivery end to the receiving end and back is thrown over the whole row on that deck, and by winding up one end of it the rolls of paper are pulled down to the delivery end as they are needed. Overhead lifts, the same as are used to unload the trucks, are used to transfer the paper from the rack to the presses, as shown in Fig. 2. The roll is picked up out of the rack in the same way as it is lifted off the truck, and is carried to the press. It is then let down on the floor and the chock is fastened in it, the roll is then again picked up by the lift, and by means of a switch in the overhead track it is carried and put in its exact place on the press. After the roll has been placed in the press, the wrapper is removed and the end of the paper is attached to that already in the press by means of a piece of adhesive tape, thus practically eliminating all wastage at the start. Notwithstanding the fact that the paper is wound on large metal cores there are several rounds which cannot be used successfully on rotary presses. Ordinarily this would be wasted, but it is stripped off, cut into sheets of a certain size and used for making other official cards which the Government has to have. Thus the wastage is practically nothing.



Fig. 1.—This rack is 210 feet long and holds 280,000 pounds of postal card paper.



Fig. 2.—The two card-printing presses with a capacity of nearly two and one-half million postal cards per day.

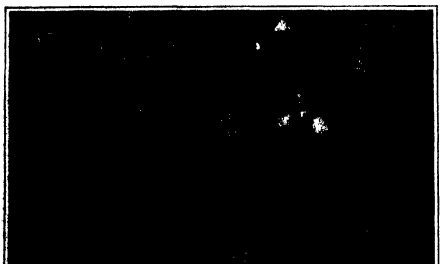


Fig. 3.—Press for printing reply cards.

Each press has two cylinders, containing several cuts each, from which the cards are printed. The two cylinders make it possible to print the reply postal cards—which must be printed on both sides—at one operation. When the ordinary postal card is printed, only one printing cylinder is used. The press shown in Fig. 3 is printing the reply cards. These are automatically cut, leaving one message and one reply card attached together. When the paper has passed over the printing cylinder it passes under a slitter, which trims the outer margins and slits the paper into eight strips, just as wide as one postal card is long.

These strips then pass under a cutter which strikes them at a speed of no less than nine strokes per second, cutting eight cards at a stroke, making seventy-two cards per second. When printing the reply cards the cutter is so adjusted as to make just half as many strokes per second. The cards are dropped in eight stacks, until these contain twenty-five each, then they are automatically carried out on the receiving table, where there are eight attendants to receive them. Each of them takes a pack, fastens a paper band around it, and drops it in a box. When the packs are coming at the rate of eight every three seconds, it is easy to see that there is no time to lose. Mr. Donnelly tells me that two machinists are working on an attachment for these presses which will strap the packages automatically. When this is completed it will diminish the cost of producing the cards several hundred dollars per year.

It has been the custom of the Post Office Department to ship the cards to large offices in wooden boxes holding ten thousand cards. They now use containers made of cardboard. By weighing we found that the one made of wood weighed ten and three-fourths pounds, while the one made of cardboard weighed one and seven-eighths pounds. There are about ninety thousand of these containers used per year. Thus the Government is saved the transportation charges on eight hundred thousand pounds of supplies carried in one year. The containers are filled and sealed near the press then stacked on a portable platform. When the platform contains as many packages as one man can readily haul on a four-wheeled truck, the truck is backed under it, and by turning a crank at one end certain parts of the truck floor are forced up at each corner, thus lifting the loaded platform off its supports and letting it rest on the truck. It is then taken to the shipping room and let down on other supports, thereby saving the time of at least two laborers.

Table of American Aeronautic Motors

Complete Specifications of the Motors of Thirty-four Manufacturers

Compiled by E. L. Jones and S. Y. Beach

Name	Bore and Stroke	Manufacturers' Rating	A. L. A. M. Rating	Number Cylinders	Cycle	Arrangement of Cylinders	Intake Valve.	Compression, Lbs.	Con. Rod Bearings.	Crankshaft Bearings.	Carburetor.	Cooling.	Oiling.	Ignition.	Material Pistons.	Material Cylinders.	Weight, Pounds.
Aircraft	4½ x 5	40	30	4	4	Vertical	M.	80	..	....	Choice.	Ei Arco.	F. F. & Sp.	Bosch.	C. I.	C. I.	260
Aircraft	4½ x 5	60	65	8	4	" V "	M.	80	..	....	Choice.	Ei Arco.	F. F. & Sp.	Bosch	C. I.	C. I.	460
Aircraft	4½ x 5	160	130	16	4	" V "	M.	80	..	....	Choice	Ei Arco.	F. F. & Sp	Bosch.	C. I.	C. I.	660
†† A. M. ..	3½ x 3½	35	34	7	4	Radial	M	86	H. B	H. B.	Schebler.	Air.	F. F.	Mea.	C. I.	Nick. Steel.	230
* I. A. M. ..	3½ x 3½	60	59	6	4	Radial	None.	80	H. B.	H. B.	Own.	Air.	F. F.	Mea.	C. I.	Nick. Steel.	300
Aaronson. ..	3½ x 3½	35	30	4	4	Horizont	A.	75	Bronze.	Bronze	Indiv Ash	Air.	F. F.	Mag.	C. I.	Steel.	194
* Avis	5½ x 5½	90	84	2	2	Opposed	None	75	Bronze.	Bronze.	Schebler	Air	Oil in Gas.		C. I.	C. I.	95
Boland	4 x 4	60	61 ‡	6	4	" V "	A	72	Bronze.	Brs. & Ball	Mayer	Water.	F.	B. or Mea	C. I.	C. I.	300
Boulevard .	4½ x 4½	30	32	4	4	Vertical	M.	90	..	....	Choice	Ei Arco.	F. F. & Sp.	Bosch.	C. I.	C. I.	150
Boulevard .	4½ x 4½	60	64	8	4	" V "	M.	90	..	....	Choice.	Ei Arco	F. F. & Sp.	Bosch.	C. I.	C. I.	250
Broderick.	5 x 5	40	40	2	2	Vertical	A	75	Bronze.	Bronze.	Choice.	Water	F. F. & Sp.	Bosch.	C. I.	Nick. Steel.	160
Brott	4½ x 4½	60	58	4	4	" V "	M	70	..	....	..	Water.	F. F.	Mea.	C. I.	C. I.	175
Call	5 x 5½	60	59	6	4	Opposed	M	96	Bronze.	Ball.	Schebler	Ei Arco	F. F.	Choice.	C. I.	C. I.	300
Call	5 x 5½	100	98	6	4	Opposed	M	96	Bronze	Ball.	Schebler	Ei Arco.	F. F. & Sp.	Choice.	C. I.	C. I.	395
Curtiss. ..	3½ x 4	25	28	4	4	Vertical	M.	..	..	....	Schebler	Ei Arco.	F. F. & Sp.	Bosch.	McAdam	C. I.	160
Curtiss	4 x 4	50	51	8	4	" V "	M	..	..	....	Schebler.	Ei Arco.	F. F.	Bosch.	ite & C. I.	C. I.	250
DeChasse	5 x 5	60	60	4	4	Vertical	M	74	..	....	Schebler.	Ei Arco.	F. F. & Sp.	A. K.	C. I.	C. I.	260
Detroit Aero	5½ x 5	90-30	84	8	4	Opposed	M	90	Die Cast.	N. D. Ball.	Schebler.	Air.	F. F.	Bosch.	C. I.	C. I.	140
† Elbridge	4½ x 4½	40	55	4	2	Vertical	None	60	Brs. & Bab.	Babbitt.	G. & A.	Ei Arco.	Oil in Gas.	Bosch.	C. I.	C. I.	196
Elbridge	4½ x 4½	60	84	6	2	Vertical	None	60	Brs. & Bab.	Babbitt.	G. & A.	Ei Arco.	Oil in Gas.	Bosch.	C. I.	C. I.	....
Emerson	5 x 5	40	40	4	4	Vertical	A and M	..	Spe. N'l Com	Spe. N'l Com	Schebler.	Ei Arco	Oil in Gas.		Spe. I.	Spe. I.	
Emerson	5 x 5	60	60	6	4	Vertical	A and M	..	Spe. N'l Com.	Spe. N'l Com	Schebler.	Ei Arco	Oil in Gas.	Mea or	Spe. I.	Spe. I.	318
Emerson	5 x 5	60	62	4	2	Vertical	None	..	Spe. N'l Com.	Spe. N'l Com.	Schebler.	Ei Arco.	Oil in Gas.	Atwater-	Spe. I.	Spe. I.	148
Emerson	5 x 5	100	96	6	2	Vertical	None	..	Spe. N'l Com.	Spe. N'l Com.	Schebler.	Ei Arco.	Oil in Gas.	Kent.	Spe. I.	Spe. I.	240
* Farwell	6 x 8	80	72	6	4	Radial	M	..	Bronze	Bronze	Own.	Air.	Mechanical	Duplex.	....	....	300
Fox	3½ x 3½	30	32	4	4	Vertical	None	..	..	Babbett	Schebler.	Water.	Oil in Gas.	Bosch.	....	....	..
Fox	3½ x 3½	36	48	6	2	Vertical	None	..	....	Babbitt.	Schebler	Water.	Oil in Gas.	Bosch.	....	....	..
Fox	4½ x 4½	60	60	4	4	Vertical	None	..	....	Babbitt.	Schebler.	Water.	Oil in Gas.	Bosch.	....	....	....
Fox	4½ x 4½	90	80	6	2	Vertical	None	..	....	Babbitt.	Schebler.	Water	Oil in Gas.	Bosch.	....	....	....
*Gyro	4½ x 4½	60	50	7	4	Radial	M	Variable	Ball.	Ball	Schebler.	Air.	Oil in Gas.		Cony Steel.	Nickel Steel.	....
Hall-Scott .	4 x 6	60	61	4	4	Vertical.	M	88	..	....	Stromberg	Hall-Scott.	F. F. & Sp.		C. I.	C. I.	150
Hall-Scott .	4 x 6	80	81	6	4	" V "	M	88	....	....	Stromberg	Hall-Scott.	F. F. & Sp.	Bosch	C. I.	C. I.	270
Hall-Scott .	4 x 6	30	36	4	2	Vertical	M	88	....	....	Stromberg	Hall-Scott.	F. F. & Sp.	or Mea.	C. I.	C. I.	148
Hall Scott	4 x 6	60	52	8	4	" V "	M	88	....	....	Stromberg	Hall-Scott.	F. F. & Sp		C. I.	C. I.	265
H DeK	5½ x 6	30 -40	38	4	4	Vertical	A.	75	Bronze	Bronze.	G. & A.	Water.	M. & Sp.	Mea.	C. I.	Steel.	160
H DeK	5½ x 6	60 -80	43	4	4	Vertical	A.	85	Bronze.	Bronze.	G. & A.	Water.	M. & Sp.	Mea.	C. I.	Steel.	265
Indian	4 x 4½	60	51	8	4	" V "	M.	..	..	....	Indian.	Water.	F. F.	Bosch.	....	....	275
* Indian	4½ x 4½	50	50	4	4	Radial	M.	..	Ball	Ball.	..	Air.	F. F.	Bosch.	....	....	....
Kirkham.	4½ x 4½	50	41	6	4	Vertical	Sliding sleev	90	Babbitt.	Babbitt.	Cluolce.	Water.	F. F. & Sp.	Simma.	C. I.	C. I.	225
Kirkham.	4½ x 4½	60	48	6	4	Vertical	Sliding sleev	90	Babbitt.	Babbitt.	Choice.	Water.	F. F. & Sp.	Simma.	C. I.	Nickel Steel.	225
Leighton	5 x 4½	40 -50		2	2	Vertical	M & A	60	Bronze.	Babbitt.	Schebler.	K. T. Co.	Oil in Gas.	A. K. H.	C. I.	C. I.	225
* Macomber	4½ x 4½	90	80	6	4	H'risont'l	M.	Variable	Ball	Ball	Choice	Air.	S.	Bosch.	C. I.	C. I.	340
Maximotor	4½ x 4½	30-40	42	4	4		A.	65	Nickel Bab	Hess Bright	Schebler		F. F. & Sp.	Mea.	Van G. I.	Van G. I.	190
Maximotor	4½ x 4½	50-60	48	6	4	Vertical	A.	65	Nickel Bab	Hess-Bright	Schebler.	and	F. F. & Sp.	Mea.	Van G. I.	Van G. I.	260
Maximotor	5 x 5	80-100	60	6	4	Vertical	A.	65	Nickel Bab	Hess-Bright	Schebler.	Ei Arco	F. F. & Sp.	Mea.	Van G. I.	Van G. I.	360
Maximotor	6 x 5	60-75	60	6	4		A.	66	Nickel Bab.	Hess Bright	Schebler.		F. F. & Sp.	Mea.	Van G. I.	Van G. I.	370
Mea	4 x 4	30	30	4	4	Vertical	M.	..	..	....	Own.	Water.	F. F. & Sp.	Mea.	C. I.	C. I.	150
* Metz	6½ x 6½	120	126	7	4	Radial	M	..	Ball	Ball.	Own	Air.	Sp.	Bosch.	Steel.	Steel.	575
* Metz.	4½ x 4½	56	57	7	4	Radial	M	..	Ball.	Ball.	Own	Air.	Sp.	Bosch.	Steel.	Steel	180
* Metz	3½ x 3½	35	34	7	4	Radial	M.	..	Ball	Ball.	Own.	Air.	Sp.	Bosch.	Steel.	Steel	130
Rine.	4 x 4	30	30	4	4	Vertical	M	..	Bronze.	White Brass.	Schebler.	Ei Arco.	F. F.	Bosch.	C. I.	C. I.	130
Rinek	4 x 4	60	61	6	4	" V "	M	..	Bronze	White Brass	Schebler	Ei Arco	F. F.	Bosch	C. I.	C. I.	240
Roberts	4½ x 5	50	52	4	2	Vertical	Rotary.	75	Brs. & Bab	Nickel Bab	Kingston	Ei Arco.	Oil in Gas.	Bosch.	C. I.	Aerolite.	180
Roberts	4½ x 5	75	79	6	2	Vertical	Rotary	75	Brs. & Bab.	Nickel Bab.	Kingston.	Ei Arco	Oil in Gas.	Bosch	C. I.	Aerolite.	280
* Rotary	3½ x 3½	35	34	7	4	Radial	M	..	..	Hess.	Schebler	Air.	F. F.	Bosch	....	Nick. Steel	160
* Rotary	4½ x 4½	50	50	7	4	Radial	M	..	Bright.	Bright.	or	Air.	F. F.	or	....	Nick. Steel	175
* Rotary	4½ x 4½	70	65	7	4	Radial	M	..	Ball.	Ball.	G. & A.	Air.	F. F.	Mea.	....	Nick. Steel	200
* Rotary	4½ x 4½	100	101	14	4	Radial.	M	..	..	....	..	Air.	F. F.		....	Nick. Steel	350
Gray Eagle	4½ x 4½	30 -40	30	4	4	Vertical	Automatic	80	Nickel Alloy	Nickel Alloy	Schebler.	Air.	S. F. & S.	Bosch	C. G. I.	Sp. Cyl. Ni.	168
* Smalley	4½ x 4½	80-100	80-80	8-6	4	Vertical	None.	..	Babbitt.	Babbitt.	Schebler	Water.	Oil in Gas.	Mea.	C. I.	Al. & I. Lea	368-318
* Stenzy	4 x 5	35	11	2	4	Tangent	A	90	..	....	Schebler.	Air.	Oil in Gas.	Bosch	C. I.	C. I.	65
* Stenzy	4 x 5	50	15	2	4	Tangent	A	70	..	....	Schebler.	Air.	Oil in Gas.	Bosch	C. I.	C. I.	80
* Stenzy	5 x 5	100	60	4	4	Tangent	A	70	..	....	Schebler.	Air.	Oil in Gas	Bosch	C. I.	C. I.	260
Waterman	4 x 4	30-30	28	4	4	Vertical	A	80	Bronze.	Special Bab.	Gr Detroit.	Water	Oil in Gas.	Bosch.	Iron.	I., Cop. Ja.	130
†† Whitehead..	4½ x 4½	30 40	45	4	2	Vertical	A	90	Bronze.	Bronze	Schebler.	Ei Arco.	Splash.	Bosch	C. I.	Steel.	140
Wolverine	5½ x 6	35-30	31	8	4	Opposed	Mechanical	60	Bronze.	Die Castings	Schebler	Air	Oil in Gas.	Bosch.	C. I	C. I.	160

WEIGHT.—The weight asked for was to cover "all essential parts, including carburetor, ignition system, lubricator, radiator, ready for fuel to start." The figures printed are those given us under this condition, unless otherwise specified in table

BLANK.—Dotted lines are used where information has been requested and not supplied.

A. L. A. M. RATING.—The A. L. A. M. formula is bore squared, times the number of cylinders, divided by 2.5. The result times 1¾ gives one rating, used above, for 2-cycle engines.

* rotating motors † The Elbridge Company makes six sizes as does the General Machinery Company †† This is also made in 50, 70 and 100 horse power sizes ‡ Made also in 60, 70, 100 and 150 horse-power sizes.

‡‡ Other sizes are 40 and 60 horse-power. The same sizes are also made in four-cycle engines.

Campaniles, Medieval and Modern

The Bankers' Trust Building—Successful Solution of a Difficult Architectural Problem

FREQUENTLY during the past few years the SCIENTIFIC AMERICAN has drawn attention to the fact that, since the modern "sky-scraper" office building has been carried up to a height which renders it nothing more nor less than a tower, the architect should treat it as such and accentuate, in his treatment of the exterior, the vertical at the expense of the horizontal lines. Frequently in earlier designs the opposite course was followed, and an attempt was made to reduce the appearance of height by running across the façade at regular intervals heavy, projecting, cornice-like bands of masonry, thus giving to the building the appearance of a series of separate structures mounted one above the other. The result was deplorable.

In the more recent tall buildings, however, our architects have frankly accepted the situation. In some cases they have taken the medieval campanile as their model, in others, they have obtained successful effects as seen in some of the competitive designs shown at architectural exhibitions, by embodying, in a broad way, the principal elements of the classic column—base, shaft, capital, frieze and cornice.

The most recent of the "tower" buildings to be erected in this city is a magnificent pile of steel and granite which stands at the corner of Nassau and Wall streets, and will be known as the Bankers' Trust Building. From a base approximately 95 feet square it rises in an extreme height of 540 feet above street level. The proportions and outline of the structure are those of the medieval campanile; the details are pure Greek, and the combination has been so successfully carried through, that we believe it will be the general consensus of opinion that the architects, Messrs. Trowbridge & Livingston, have produced in this structure the most harmonious and dignified building of its type in this or any other American city. Particularly are they to be commended for heightening the æsthetic appearance of the structure by abolishing all windows from the pyramidal structure which forms the huge capstone of the tower, and carrying up the stone work in a series of massive steps rather than in plane surfaces. The many-windowed pyramid is an anachronism of the most painful kind; whereas the stepped surface is perfectly harmonious with classic ideas, being suggestive, indeed, in the present case, of the ancient mausoleum of Halicarnassus.

By way of accentuating at once both the similarities and the differences between the medieval and the modern campanile, our artist has imposed his drawing of the Bankers' Trust Building upon a photograph of the famous St. Mark's Square, Venice. The modern building has been placed at the same distance from the eye as the old Venetian campanile, so that the two appear upon the same scale, and the observer receives a just impression of their relative heights and other proportions. The Venetian tower stood 323 feet in height upon a base which was approximately 42 feet square. It will be noted at once that the pyramidal portion of the Venetian tower has a much steeper inclination; in which respect the pyramidian of the Metropolitan Building follows more nearly the Venetian model. The inclination of the Bankers' Trust walls is 70 degrees, and that of the mausoleum of Halicarnassus was 45 degrees. We think it will be agreed that the architects have adopted a judicious compromise.

Before passing to a description of the engineering and constructional features of the building, it is well to mention here that the preparation of the site involved the purchase and complete removal of the Gillender Building, built less than fifteen years ago, a modern eighteen-story steel-and-stone structure, which stood on a limited plot at the corner of Nassau and Wall streets. For the reason that its rentable floor surface was too greatly reduced by the elimination of the space necessary for elevators, stairways and corridors, this building had never been a paying proposition. To allow the old building to stand and carry the new structure around it in the form of an L, would have been to cut out the major portion of the light and air—elements of prime importance in determining the rentable value of a modern office building. It took only a few minutes figuring with pencil and pad to prove that it would be a more profitable investment to buy and destroy this eighteen-story steel building, and erect a new thirty-story structure upon the whole corner plot, 97 by 94¼ feet, thus secured.

Alike in the wrecking of the old building, the preparation of the foundations and the erection of the new structure, all previous records for rapid work have been surpassed, as the following dates will show. The wrecking of the Gillender building was commenced April 29th, 1915. Forty-five days later it had disappeared. On June 15th work on the foundations commenced; and on November 1st, 1915, the first steel columns of the new building were erected. By June 6th, 1916, the steel work had been carried to complete to its full height of 502 feet above the foundation footings, and by September 1st, the stone work will have been finished also. The erection of the stone work, by the way, has been particularly rapid, the average rate of progress having been 3½ stories per week. Such expeditious work was made possible

to three causes; first, that all office work upon plans, etc, has been done far in advance of the building, this being true of the smallest details; secondly, that the granite work, even to the cutting out of the checks to receive the projecting portions of the steel, was completed before the stone was shipped to the site; and, thirdly, that the contractors, Marc Eidlitz & Sons, had perfected an organization by which material was brought to the building only as it was required and always slightly in advance of the demands of the erectors.

We dwell at some length upon this feature, since it is largely in standardization of materials, accurate shop work, and highly specialized organization of the erection forces at the site, that American architects and builders have succeeded in prosecuting their work at a speed which is not approached in any other part of the world. As an instance of high-class erection, it may be recorded that the work of Post & McCord, who had the contract for the steel, was so accurate that the columns, in the course of their progress to a total height of nearly 600 feet, have not varied more than a quarter of an inch from the plumb line. That this speed of erection has not been due to reckless haste is shown by the fact that it was marked by but one accident.

Although, architecturally speaking, the chief interest in this building is to be found above street level, its interest from the engineering standpoint lies in the work which has been done below the sidewalk, in preparing the foundations. Here a system has been adopted which the architects believe is destined, because of its many advantages, to become standard practice in lower Manhattan. The old method of preparing foundations was to sink concrete-filled caissons through the water-soaked sand and silt, which overlie the bed rock, and erect upon these the footings for the steel columns. Usually a caisson was sunk for each line of columns. These caissons which would be anywhere from 8 to 25 feet in their largest diameter, naturally occupied a large amount of the valuable space below street level, which is used for basement, engine room, storage and other purposes. Furthermore, there were objections to this method, due to the difficulty of waterproofing and excluding moisture from the steel footings of the columns

The new system, as adopted in the Bankers' Trust Building, is to sink a continuous steel-and-concrete cofferdam wall entirely around the plot on which the building is to be constructed, extending the wall everywhere down to solid rock, with which it forms a water-tight contact, and carrying it up everywhere above water level. When the wall, which is 7 feet in thickness throughout, had been completed, the sand and silt and the caissons of the old Gillender Building were removed, until the underlying rock was exposed. During the progress of excavation a framework of heavy timber struts was built from wall to wall, for the purpose of counteracting the outside pressure of the water-soaked silt, which reached a maximum of 3,360 pounds per square foot. When the excavation had been completed, the footings for the foundations of the steel columns were prepared, and the erection of the steel skeleton commenced. On the sides of the plot contiguous to existing buildings, the columns were erected upon the cofferdam wall. On the sides abutting on the streets, the footings were placed on the solid rock contiguous to the wall.

The advantages of this system of construction are several. In the first place, the steel work is open to inspection right down to the mother rock. In the second place, the exceedingly valuable space below the sidewalk is rid of the cumbersome caissons, whose place is taken by the comparatively slight bulk of the columns. It is the belief of Mr Trowbridge that ultimately, on the reconstruction of the city, whole blocks will be syndicated, and a continuous cofferdam wall will be run around each block. This will result in a great saving in foundation work, the columns springing, as in the Bankers' Trust Building, directly from bed rock, while the heavy interior partition walls which now separate the various buildings on a given block will be unnecessary, and light partition walls will take their place.

It can readily be seen that should a whole section of the city be thus founded, the space below the streets, between caisson walls of opposite blocks, would form an admirable three or four story subway, in which to place city traction lines, and carry the gas and water mains and the electric cables for light and power purposes.

By embedding in the horizontal framing steel girders of sufficient depth and section, the bending stresses due to wind pressure have been provided for. Moreover, the inertia of the great mass of the building, whose total weight is approximately 50,000 tons, will absorb the shock of the heavier gusts of a thunder storm or tornado.

The interior finish of the building is thoroughly fireproof. No wood whatever has been used. The doors are of steel, and the trim, window sashes, etc, are also of metal. Granolithic floors with marble base-boards, have been laid throughout Wire-plate glass has been used everywhere in interior partitions. In the basement are powerful fire pumps, and large tanks have been installed in the roof The use of the pyramidal roof structure entirely for storage purposes is a novel feature. It is reached by elevator, and each of its seven floors is provided with an interior gallery, from which burglar-proof doors open into the several storage rooms thus provided It is a curious fact that, although lower Manhattan is so abundantly provided with safe-deposit vaults, there is not a single storage warehouse in which bulky materials, such as office furniture, can be placed for safe keeping

The total cost of the building is about $4,000,000. Its location in the very heart of the Wall Street district, and its advantages of light and outlook, have combined to raise its rental to the highest figure yet recorded for commercial buildings of this type.

An American "Comptes Rendus"

THE *Comptes Rendus Hebdomadaires*—the pink-covered weekly organ of the French Academy of Sciences, so familiar to every scientific man—is an epitome of the progress of science in France Its cardinal virtue is conciseness A *savant* will spend years in elaborating some epoch-making discovery—and announce the same in a laconic page or two, confident that his announcement will presently be read in every corner of the world.

Although in America we have no intellectual metropolis in the same sense that France has, yet our political capital—the seat of the great scientific departments of the government, and of the Smithsonian and Carnegie institutions—holds a somewhat analogous position It therefore appears fitting that the Washington Academy of Sciences—the focus of the scientific community at the capital—has undertaken to publish what promises to be a sort of American *Comptes Rendus* This publication, the *Journal of the Washington Academy of Sciences*, will appear semi-monthly, beginning July 15th, 1911, and will replace the *Proceedings* of the same academy, than which it will have a far wider scope.

In the new publication will be recorded the results of all kinds of scientific work carried on by the Government, as well as by non-official institutions and individuals at Washington, or connected with the scientific organizations of that city Each scientific bureau of the Government has been asked to designate some one who will forward to the editors such material as the bureaus are willing to have published in this way. This material may take the form of preliminary statements concerning work nearing completion, abstracts (preferably by the authors) of papers recently published by the bureaus, or complete short articles. The journal will also contain notes of events connected with the scientific life of Washington.

The editors responsible for the successful inauguration of this new enterprise—which is viewed with deep interest by scientific men, in and out of the capital—are G K Burgess, of the Bureau of Standards, B. W Evermann, of the Bureau of Fisheries, and F. L. Ransome, of the Geological Survey.

The principal function of the new journal will undoubtedly be to place before the world, in a concise and easily accessible form, the cream of the information now consigned to a host of official publications, most of which fail to reach a majority of the readers who would find them of interest

Asteroid Notes for the Month of July

OF the asteroids, Vesta is too near the Sun to be seen during the month of July Below we give the ephemeris for Pallas, Ceres and Juno Several have written that they have succeeded in finding one or more of the small planets by the aid of the ephemeris given heretofore. Usually a really good pair of field glasses or a small telescope is all that is needed. For one who has not as yet succeeded in finding one of these, our small neighbors, we suggest that a good pair of field glasses be used and an asteroid selected that is of good magnitude and favorably located. Possibly Ceres will be as good as any for the month of July. It is under the ninth magnitude, constantly growing brighter, and very close to Zeta Tauri on July 15th about 2 A M. At this time the R. A. of Ceres is 5 hours 32 minutes, and its Dec. is +22° 18'. The R. A of Zeta Tauri is 5 hours 32 minutes, and its Dec is +21° 6'. So Ceres will be one degree directly north of Zeta Tauri at this time.

Pallas should be easily found. During the last days of June it moves directly north of Delta Ceti, and by July 1st forms a small triangle with Delta and Gamma Ceti. By the close of the month it passes just to the north of 91 and 95 Ceti. Pallas is also in the morning sky during July.

Juno is still growing fainter—of the 10.5 magnitude on July 11th. However, it is no near Delta Virginis on July 4th that it should be easily seen in even a moderate sized telescope It will be remembered that on April 28th it was very close to this same star (See ephemeris and notes in SCIENTIFIC AMERICAN for April 1st) The R A of Delta Virginis is 12 hours 51 minutes, and its Dec. 3° 52' N. On July 4th the R A of Juno will be 12 hours 51 minutes, and its Dec 3° 41' In other words, it will be about a sixth of a degree south of Delta Virginis On April 28th it was one-tenth of a degree due north of it. It is interesting to note its course during these last months Note the ephemeris for April and follow its motion on the star atlas. It continued to move south till June 1st, when it was stationary, with an R A of 12 hours 41 minutes and a Dec. of N. 5° 10'. It is now retracing its steps exactly.

CERES.

Date.	Mag	R. A.	Dec.
July 3	8.87	5 hr. 12.4 min.	21° 39'
July 11		5 " 26.5 "	22° 7'
July 19		5 " 40.5 "	22° 30'
July 27	8.76	5 " 54.5 "	22° 49'

PALLAS

Date.	Mag	R A.	Dec.
July 3 ..	9.16	2 hr. 41.8 min	N 0° 19'
July 11		2 " 53.8 "	S 0° 7'
July 19		3 " 4.5 "	S 0° 43'
July 27	8.85	3 " 15.4 "	1° 30'

JUNO

Date.	Mag	R A.	Dec
July 3	10.41	12 hr 50.8 min	N 3° 46'
July 11		12 " 55.6 "	3° 10'
July 19 .		13 " 1.1 "	2° 29'
July 27 .	10.67	13 " 7.4 "	1° 45'

Title Pages for the Scientific American

THE present number of the SCIENTIFIC AMERICAN marks the beginning of a new volume Contrary to our practice in former years, we have not included the usual volume title page Those of our readers who wish to bind up the last volume will receive a title page on application to this office

The Current Supplement

THE opening article of the current SUPPLEMENT, No 1852, deals with the new Campanile at Venice —Dr. L A Bauer describes some of the problems of ocean magnetic work.—A remarkable paper was recently read by Major George D. Squier before the American Institute of Electrical Engineers, on "Multiplex Telegraphy and Telephony by Means of Electric Waves Guided by Wires" This paper is published —The fourth installment of Sir J J Thomson's brilliant Royal Institution lectures on "Radiant Energy and Matter" finds a place in the current SUPPLEMENT— Other articles of interest are the following "The Principles of Original Research," by Prof Sedgwick Minot, "The Sun's Distance," by Prof J H Ogburn; "An Important Report on Sewage Disposal Investigations", "Some Recent Types of Aeroplanes", "Some Recent New Inventions", "Chemical Research and Industrial Progress," and "A New Spectroscope and Spectrograph."

Cork Varnish for Ships

IN order to protect the interior of ships from the humidity caused by condensation upon the metallic walls during sudden changes of temperature, the Italian marine has experimented with a kind of hygroscopic varnish, or coating, the essential compound of which is ground cork, which is consolidated by pressure with copal and litharge, and applied to the walls It has been found that the cork varnish absorbs the watery vapor of the atmosphere to the extent of eight or nine grammes for every square meter of surface exposed.

A Gasoline Tool Car for Railways

THE Chicago and Rock Island Railroad is using a gasoline car to convey men and tools to any point where repairs or construction work are needed The car not only transports tools and men but supplies the necessary power for operating electric tools A 30 horse-power, 4-cylinder, 4-cycle gasoline engine drives a generator which supplies power for operating electric tools. These tools are Two electric spike screwing machines, six electric drills, one electric saw for rails, and portable emery wheels The car can carry 8 to 10 men and any reasonable equipment of tools.

The New White Star Liner "Olympic"

A Ship 882½ Feet Long, That Weighs When Fully Loaded 66,000 Tons

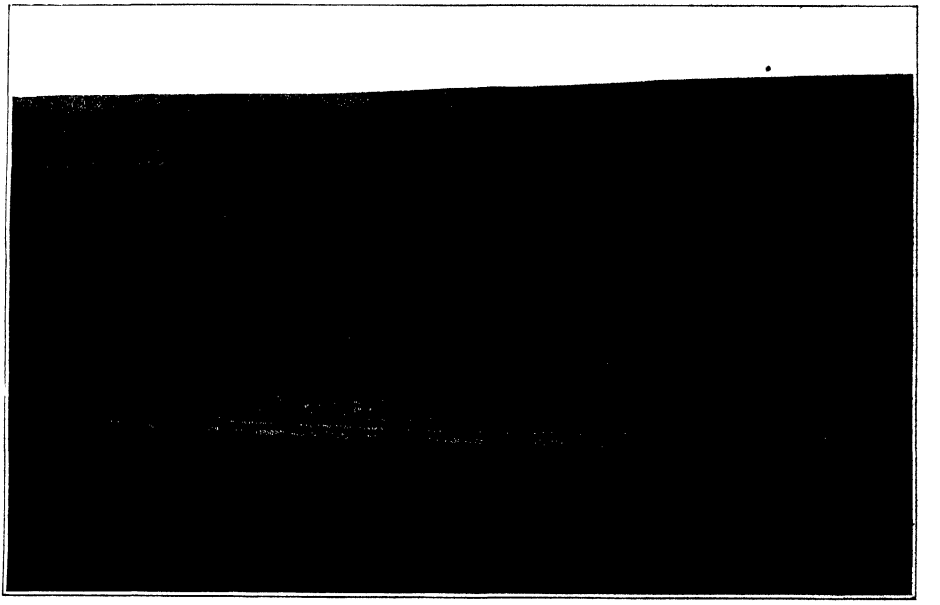
THE arrival of the White Star liner "Olympic" at New York sets another mark in the growth of the modern ocean liner toward the ship one thousand feet long The story of the development of the trans-Atlantic liner is full of interest, and it is worthy of note that until of late years, the growth in size and speed, if we except the case of the "Great Eastern," has been by regular and fairly even advances Thus the "Britannia," of 1840, 207 feet long, had an average speed of 8 5 knots per hour The "Asia," of 1850, 266 feet long, and of 12 5-knot speed, had a gross tonnage of 2,226. The "Scotia," of 1862, 379 feet long, and of 14.4-knot speed, had a gross tonnage of 3,871 The "Bothnia," of 1874, was 420 feet long, had a gross tounage of 4,556 and a speed of 13 8 knots The "Servia," of 1881, 515 feet long, was of 7,392 gross tonnage, and her speed was 16 7 knots The "Ivernia," one of the type of mixed cargo and passenger ships of moderate speed, which have now become so popular, launched in 1900, was 580 feet long, had 14,027 gross tonnage, and a moderate speed of 15 25 knots The "Campania," 600 feet long, of 12,952 tons gross tonnage, with a speed of 22 knots, launched in 1893, was the first vessel to reach a length of 600 feet between the perpendiculars The "Coronia," launched in 1905, was 650 feet long, with a displacement of 20,000 tons The first ship to exceed a length of 700 feet was the White Star liner "Oceanic," whose length on deck was 704 feet Then followed the "Lusitania" and "Mauretania," 790 feet in length, of 53,000 gross tonnage, with respective sea spee of 25½ and 26 knots per hour, both of which ships made their appearance about 1907 And now, in the "Olympic" and the sister ship "Titanic," we have the first vessels to exceed a length of 800 feet, reaching, indeed, almost to the 900 feet length while their gross tonnage has gone up to 45,324, and their displacement at maximum draft has reached 66,000 tons

Although the "Olympic" is not so fast a vessel as the "Mauretania," she is capable, when pushed, of a speed of 22 knots and, like those vessels, she is, to all intents and purposes, a purely high-class passenger ship Although it is possible to stow in her hold about 6,000 tons of freight, it is rarely that she will carry more than about 2,000 tons, for her time in port will be almost entirely given up to coaling and getting ready the accommodations for her complement of over 3,000 souls, and caring for the engines and boilers necessary to enable her to develop her maximum horse-power of 50,000.

On this, her maiden voyage, she left Southampton at noon on Wednesday, June 14th, called at Cherbourg and Queenstown, and left Queenstown on Thursday. She was at her dock early on Wednesday morning, having completed the trip from Southampton at an average speed of 21 17 knots As she steamed majestically up the North River, and warped in alongside of her pier, the "Olympic" looked every inch of her length and height, and fully came up to the expectations which had been raised by the published description of her vast dimensions What these are may be gathered from the following figures: Length on deck, 882½ feet; breadth, 92½ feet, breadth over boat deck, 94 feet, height from keel to boat deck, 97 feet 4 inches. At a draft of 32 feet, which the vessel drew on entering the harbor, the height of the boat deck above the water line is 62 feet 4 inches The height from the keel to the roof of the captain's house is 105 feet 7 inches, and from the keel to the top of the funnels, 24 feet in diameter, 175 feet. Including the floor of the ship at the double bottom, the vessel has 11 steel decks, and her molded depth, that is, the depth to which the solid steel plating of the hull is carried up and broken, is nearly 70 feet, or fully one deck deeper than that of any previous ship. Her gross registered tonnage is 45,324, and her net tonnage 20,894. When the ship is fully loaded to her maximum possible draft, she will displace, or weigh, 66,000 tons

Now, in view of the fact that the "Olympic" exceeds the "Mauretania" by only 92 feet in length and by 4½ feet in breadth, the fact that her displacement is nearly 50 per cent greater, or 66,000 tons against 45,000, needs some explanation. The greater displacement is due to the fact that the model of the "Olympic" is very much fuller, her sides for several hundred feet amidships being practically parallel—the hull, indeed, consisting of a long, parallel body, with a rather fine entrance and delivery. This form is admissible in a vessel of 21 to 22-knots speed; but when we come to vessels driven at from 25 to 26 knots, as are the "Lusitania" and the "Mauretania," fineness of form becomes a prime consideration. It is a fact that there is scarcely a straight line to be found in the underwater body of the two Cunard liners. This fining down of the hull reduces the displacement, and hence the wide difference in the figures for the White Star and the Cunard vessels.

The maximum horse-power of the "Olympic" is 50,000; that of the "Mauretania," 80,000. This disparity in horse-power is perfectly in keeping with what we have said regarding the form of hull, displacement, and speed of the two ships. High speed, after 21 knots has been passed, is obtained only by a large addition to the horse-power, which, for the same vessel, increases as the cube of the speed. Hence, in spite of the finer lines of the "Mauretania," it takes 80,000 horse-power to drive her 45,325 tons of weight through the water at 26 knots, as against 50,000 horse-power to drive the 66,000 tons of the "Olympic" at 21 knots As a matter of fact, the speeds quoted could be obtained only on smaller draft and lighter displacement, say about 40,000 tons for the "Mauretania" and 58,000 tons for the "Olympic."



Length, 882 1/2 feet; beam, 92 1/2 feet; molded depth, 70 feet; displacement on maximum depth, 66,000 tons; horse-power, 50,000; maximum speed, 23 knots; passengers and crew, 3,200.

ARRIVAL OF THE WHITE STAR LINER "OLYMPIC" AT NEW YORK

The weights of various parts of the "Olympic" necessarily run to large figures. The largest plates on the hull weigh 4½ tons; the rudder weighs 100 tons; the anchors, 15½ tons each; the center propeller, driven by the turbine engine, weighs 22 tons, and the two wing propellers, driven by reciprocating engines, weigh 38 tons each. The weight of each link in the anchor chain is 175 pounds.

The engine room plant of the "Olympic" embodies the latest ideas in marine engineering. Steam from the boilers is expanded down through the higher ranges of pressure in two reciprocating engines, each driving its own propeller. From the reciprocating engines the steam is led to a large low-pressure turbine, which drives directly a central propeller. This combination secures a more economical use of the steam than is possible with an all-turbine plant. Moreover, it per-

make the several propellers to be driven more nearly at their best economical speed. It is known that the "Mauretania" consumes about 1,000 tons of coal per day; it is not probable that the "Olympic" will burn over 700 tons per day, if, indeed, she does not come below that figure.

Naturally, a ship of this great size has accommodation for a small townful of people (3,356, as a matter of fact), of whom 750 are accommodated in the first class, 550 in the second, and 1,200 in the third; while the balance is made up of 63 officers and sailors, 322 engineers and firemen, oilers, etc., and 471 stewards, waiters and other members of the commissary department.

An interesting structural feature in the ship is the special provision which has been made for strengthening her long hull to resist the heavy bending stresses to which it will be subjected when driving into a heavy sea and riding over the waves. Some years ago, in our issue of November 10th, 1900, we made a study of some of the possible features which would be incorporated in the future four-day liner, should such a 30-knot ship ever make its appearance. We found that, to give a ship of the great length required sufficient longitudinal strength, it would be necessary to run a plate girder on bulkhead through the center of the ship for several hundred feet amidship, with extra thickness of plating at the top and bottom of this girder, and also at the top and bottom of the shell plating of the vessel. It is interesting to note that the "Olympic" has been strengthened by running four longitudinal girders through the ship for this same purpose, girders extending from the keel up through several decks.

Although we are mainly concerned with the technical features of the "Olympic," this article would be incomplete without some reference to the unusual accommodations provided for the comfort and entertainment of the passengers. In the first place, the deck accommodations are superb, the boat deck, between 60 and 70 feet above the water, being singularly free from ventilators, deck engines and similar obstructions. The bridge deck promenade alone is 550 feet long, and other promenade accommodations through the ship are in proportion. The main dining saloon, which extends the full width of the ship, is over 90 feet wide by 114 feet in length, and it can seat 532 people. Beyond, and really forming a part of it, is a spacious lounge where passengers may assemble before entering the dining room. A notable feature in this room is the nine of the windows, each of which is lighted by two large port holes, one above the other, the light being softened by passing through leaded windows. The main lounge, finished in light oak, is a superb room in the Louis XV. style, measuring 62 by 60 feet; and rivaling it in its proportions and magnificence, is a smoking room of equal size. A notable feature in these rooms is the use of large bay windows, filled with leaded glass, which strongly accentuates the effect which they produce of being large apartments in some stately manor house of the older countries. A swimming pool 32 feet long, a racquet court 30 feet long, and a very complete gymnasium, are among the features provided for the recreation of the passengers. Lastly, mention should be made of the 69 separate suites of apartments, decorated in the Empire, Louis XV., Georgian, Queen Anne, and Dutch styles, which are available for the use of those passengers who are willing to pay from $1,250 to $2,250 for the privilege of occupancy.

An Important Contribution to the Nitrogen Problem

IN many soils the amount of nitrogen present is the factor that limits the size of the crop of grains, potatoes and other non-leguminous plants. Not only is the size of the crop limited, the plants growing on such soils have a lower percentage of protein than the same kinds of plants grown on soils with an abundance of nitrogen in suitable combinations.

Experiments conducted during the past few years at the Cornell University Agricultural Experiment Station by T. L. Lyon and James A. Bizzell have shown that in addition to restoring to the soil a quantity of nitrogen compounds, which are later available for other crops, the growth of legumes may also furnish nitrogenous food to other plants growing with them, and then influence the nitrification of the soil besides.

The following table combines the results of several experiments:

TABLE SHOWING THE PERCENTAGE OF PROTEIN IN GRAIN CROPS GROWN ALONE AND WITH LEGUMES

Grain grown alone (Grain crop)	Percentage of protein		Grain grown with legume (Legume)
Timothy	12.75	15.56	Alfalfa
Timothy	9.00	9.69	Alfalfa
Timothy	17.19	24.58	Red clover
Oats	12.69	13.44	Peas
Oats	14.94	16.19	Peas
Oats	10.50	14.06	Peas

In earlier experiments the yield of the soil that had borne one or more crops of legumes was compared with soil upon which plants of this family had never been grown before. In the present experiments the two kinds of plants were sown together. A comparison of the total yield is shown in the next table, wherein are compared the pounds of hay per acre when oats was grown alone with the yield of hay when oats was grown with peas, on two different soils:

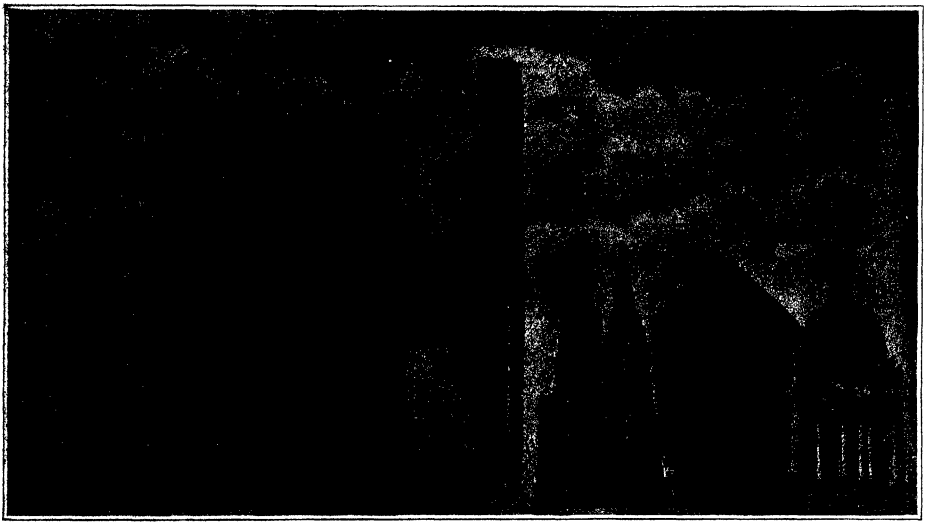
POUNDS OF HAY PER ACRE

Oats alone	Oats and Peas
3,750	4,850
2,900	3,900

Other tables in the original paper show the total proteins per ton of yield to be likewise in favor of the grain raised in combination with the legume. The increased protein content of the hay makes it of greater food value.

On certain plots alfalfa was grown for five years; on others with the same kinds of soils, timothy was grown for five years. At the end of this time there was found a larger percentage of nitrates in the alfalfa soil than in the timothy soil, as was to have been expected. But on similar plots which were kept bare for a season after the removal of the plants the same differences were observed. This suggested that nitrification continues after the removal of the alfalfa, and actual experiments with samples of soils in flasks showed that such is really the case. The rate of nitrification, or of converting ammonia into nitrates, is of great importance in agriculture, since it determines the amount of nitrate that will be available for the crop. Samples of soil were tested for the nitrates present, weighed quantities of ammonium sulphate were added and the nitrate test again repeated after ten days. In every case the soil that had borne alfalfa showed greater nitrification than soil that had not borne a leguminous crop. At the end of twenty days all of the ammonia had been nitrified in all of the soils. In other words, the rate of nitrification is decidedly influenced by the fact that alfalfa had been grown on the soil.

The effect of liming upon soils with and without legumes was also studied, and the advantage of liming shown to lie in the influence it has upon the rate of nitrification.



Bunker Hill Shaft. | Philadelphia City Hall. | Washington Monument. | Metropolitan Tower. | Woolworth Building. | S. S. Olympic, 882¼ Feet. | Cologne Cathedral. | The Great Pyramid. | St. Paul's, London.

COMPARISON OF THE "OLYMPIC," 882¼ FEET IN LENGTH, WITH SOME TALL BUILDINGS OF THE WORLD

The Largest Radiator in the World

HIGH-POWERED motors require large radiators, and Consul General T. St. John Gaffney of Dresden describes what is termed the largest radiator in the world. It is intended for the 300 horse-power motor of an airship, is made of aluminium, is 4 feet 7 inches high, 4 feet 7 inches broad and 8 inches deep. Its economy of operation is indicated by an hourly capacity of 6,868 gallons and a radiation of not less than 288,000 calories per hour, while 1,695,000 cubic feet of air pass through it. Its weight is: Empty, 145 pounds, and 209 pounds when full of water.

The Heavens in July

Motions of Stars in Corona Borealis; Two Remarkable Double Stars; the Planets in July

By Henry Norris Russell, Ph.D.

CORONA Borealis—the Northern Crown—though not one of the brightest constellations is conspicuous enough to deserve inclusion in our list of initial illustrations. It is very easy to recognize. The semicircle of seven stars, on the line joining Arcturus and Vega, and nearer the former, cannot be mistaken for any other configuration, and stands out among the neighboring stars clearly enough to convince us that this is a natural constellation—if we may so speak—and not merely a group with arbitrarily assigned boundaries.

It has also the somewhat unusual distinction of bearing some resemblance to the object for which it is named. Though much less complete than the wreath of oak leaves which our initial represents, its form certainly suggests a wreath or crown of some sort.

The first really astronomical question which a look at this group suggests is: Are these stars really near each other—comparatively speaking—and arranged along a semicircle, or is their apparently *symmetrical grouping* merely an effect of chance?

That the latter alternative is the true one is shown by a study of their proper motions—that is, of the motions, apparently slow but really rapid, which the stars themselves possess in space.

No two of the seven stars composing the circlet are moving in the same direction, or at the same rate. The two brightest, Alpha and Beta Coronae, are moving in opposite directions and have nearly exchanged places in the past fifty thousand years (which is a short time in the history of a star). At an equal interval hence, they will be apparently three times as far apart as they are now, and some of the other stars will also have moved so far that the group will bear no resemblance at all to its present aspect.

It may seem a bold prophecy to predict at all what a constellation will look like after so long a time, but the change in a star's position which would be necessary to alter the appearance of the group to the naked eye is several thousand times as great as the amount which can be detected by accurate measurements with suitable telescopes. We have accurate observations of these stars covering over a century and from these their motions can be determined, and their positions predicted, even a thousand centuries hence, more accurately than naked-eye estimates could determine them then.

Some of the individual stars of the group deserve mention. Their real brightness, and their distances from us, presumably vary as much from star to star as do the directions and rates of their proper motion. For only one of the brighter stars do we have any trustworthy determination of these quantities: the brightest of all, sometimes called *Gemma*, which belongs to the group of stars which also includes Sirius and several of the brightest objects in Ursa Major (a description of which was given in our issue of April 2nd, 1910). Its distance appears to be about seventy-eight years, and its actual brightness some sixty times that of our Sun.

There are several interesting double stars which deserve our notice. Two are rapid binaries. One of these, Gamma Coronae, which lies next to *Gemma* on the east, is too close and unequal a pair to be separated by any but powerful telescopes. The other, Eta Coronae, may be found by drawing a line from *Gemma* through the next star to the westward, and carrying it on about two-thirds as far again. This fine and nearly equal pair is now at its greatest separation (about 1 second), and can be seen double with five inches or more of aperture. The period is 41½ years, and three revolutions have been completed since the first observation by Herschel in 1781.

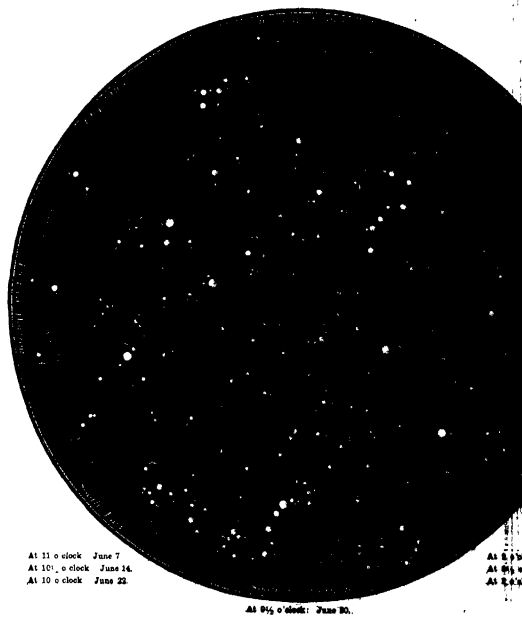
Observers with smaller instruments will find objects of interest in ν and σ Coronae—two small stars, not shown on the map, but easily picked up near the intersection of lines drawn from β through ζ Herculis, and from η Herculis to α Coronae.

Sigma Coronae, the westernmost of the two, is a binary of long period—350 years or more. The components, of the 5th and 6th magnitudes, are now 5 seconds apart, and can be separated by a small telescope.

Nu Coronae, the eastern of the two, is a very wide double, separable even by the naked eye, and widely divided by a field-glass. The two components are moving in opposite directions, and their apparent proximity is only accidental.

West of Corona (which at the time for which our map is drawn is nearly overhead) is Boötes, marked by the splendid orange star Arcturus. Below in the southwest is Virgo, with the very bright planet Jupiter outshining all her stars. Leo is low in the west, and Ursa Major well down in the northwest.

Ursa Minor and Draco are between the pole and the zenith. Cassiopeia and Cepheus are low in the northeast. Cygnus and Aquila occupy the Milky Way in the east, with Lyra above them, and Hercules still higher up. Capricornus is rising in the southeast, and Sagittarius farther to the southward. Scorpio shows splendidly in the southern sky, the whole curve of his tail being well visible, and Ophiuchus and Serpens are above.



NIGHT SKY: JUNE AND JULY

THE PLANETS.

Mercury is in conjunction with the Sun on the 3rd, and is invisible, except perhaps at the end of the month, when he sets about 8:15 P. M. and may be seen as an evening star. On the 29th he is close to the bright star Regulus, but both are low in the twilight. Venus is evening star in Leo and reaches her greatest elongation (or apparent distance from the Sun) on the 6th. She remains in sight until nearly 10 P. M. on the 1st, but, being farther southward nearer the Sun, sets about 9 o'clock at the end of the month. She appears telescopically as a fine moon at the beginning of the month and as a slender crescent at its close, and to the naked eye is near her greatest brilliancy.

Mars is in Aries, rising about midnight in the middle of the month. He is slowly moving eastward toward Saturn, and overtakes him in August.

Jupiter is in Virgo and adorns the evening sky. He is in quadrature with the Sun on the 29th, and is due south at 6 P. M.

Saturn is in Aries, a little east of Mars, and rises about an hour later.

Uranus is in opposition on the 20th, on which date he is in R. A. 19 h. 38 m. 21 s., declination 21° 30' 37" south, and is moving 10 s. west and 28" south per day. These data will enable those provided with setting circles on their telescopes to find him at once. Otherwise we may proceed as follows. A line from γ Sagittarii through a point half way between ζ and τ in the same constellation, carried as far again, points out a group of four small stars. Uranus is just half way between these and β Capricorni, in a very barren region. He appears as a star of the sixth magnitude, barely visible to the naked eye.

Neptune is in conjunction with the Sun on the 14th and is invisible throughout the month.

The Moon is nearest us on the 24th and farthest away on the 8th. She is in her first quarter at 4 A. M. on the 3rd, full at 7 A. M. on the 11th, in her last quarter at midnight on the 18th, and new at 3 P. M. on the 25th. Since new Moon comes so near perigee we may expect unusually high tides about this time, and also unusually low tides, the range of the tide being increased, but the average level of the sea remaining unchanged.

In her circuit of the heavens our satellite comes nearly in line with Jupiter on the 5th, Uranus on the 12th, Mars on the 19th, Saturn on the 20th, Neptune on the 24th, Mercury on the 27th, and Venus on the 28th. The conjunction with Jupiter is fairly close, but takes place after the Moon has set upon our part of the world.

Princeton University Observatory.

Peruvian Petroleum

EFFORTS are being made to develop more extensively the petroleum resources of Peru. The known deposits of oil occur in a very narrow strip of land between the foothills of the Andes and the shore of the Pacific, and much of this is flooded at high tide. Piles of railroad iron driven in the open ocean sand, which varies in depth from 5 to 30 feet, are used as foundations for the derricks. The shallowest of the driven wells is 1,000 feet in depth. There is very little gas, and the oil is very heavy, so that it can be put into tanks and shipped, and it is carried direct to the [illegible]

Curiosities of Science and Invention

Automobile Bridges in California

EXCEPT for a few streams which become flooded, and therefore impassable, during the rainy season, conditions in California are ideal for touring the year around. But until the Automobile Club of Southern California began its active agitation in the matter of good roads there was no effort to bridge these streams, and whole sections of the country were at times completely closed off from the rest of the world, the fords being impassable from floods and quicksands. Particularly was this the case in San Diego County at the crossing of the San Mateo and Santa Margarita rivers; and as visiting motorists in California all desired to go to San Diego by automobile, some means of transportation across these washes had to be devised. They had to be temporary, not only because of the expense of permanent bridges, but also because the club expected to succeed in its efforts to have permanent bridges built by the county. Accordingly, the club engineer devised the automobile bridge shown in the illustration. It is built of channel-iron 10 inches wide and 6 inches deep, braced together with iron strips, giving a spread of 56 inches over all, thus allowing the use of 6-inch tires and taking care of the average car.

The approaches to the bridge were built of wood, and the channel-iron troughs were raised upon concrete piers. One of these bridges was 84 feet long, not counting the approaches, and the other measured about 52 feet.



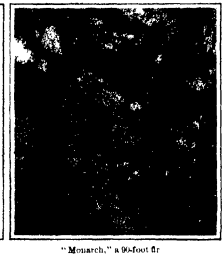
Auto bridge over the Santa Margarita, California.



Odd method of launching a boat in China.



"Queen of the Forest"

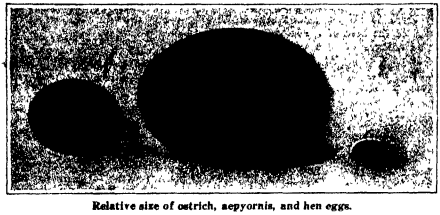


"Monarch," a 96-foot fir

The "stone forest" of California.

The Largest Egg in the World

AN egg of the gigantic extinct bird aepyornis of South Madagascar is on exhibition at the Museum of Natural History, New York. The enormous size of the egg may be gleaned from the accompanying photographs. In one illustration a full grown pigeon is shown standing beside the huge egg, and in the other picture on the right is seen an ordinary hen egg; on the left is the egg of an ostrich. The aepyornis egg has a capacity of two gallons, or 150 times that of a hen's egg. The shell is ⅛ inch thick. Lengthwise it is 32 inches in circumference and it measures 26 inches around the middle. Though termed a fossil egg it is not petrified, but is in perfect condition, unbroken, and has a yellow color. The contents have turned into a fine dust which comes out, when handled, through a small natural perforation on one side. The aepyornis, like the moa of New Zealand, was exterminated by the hand of man. A few centuries ago it was quite abundant. Several incomplete fossil remains have been discovered, but no complete skeleton has ever yet been found. These show the bird was three-toed, of massive proportions and short winged. The Madagascar natives have for many years used the great egg shell for various household purposes. In fact, the first knowledge of these eggs became known when some Madagascar natives came to the Mauritius to buy rum, bringing the Aepyornis eggs with them to hold the liquor. Only three or four of these huge eggs have been brought into civilization. The present one is the most perfect as well as the largest known.



Relative size of ostrich, aepyornis, and hen eggs.



Aepyornis egg compared with a pigeon.

Launching a Boat in China

THE accompanying picture of a motor boat shows the ingenious method that the Chinese have for launching. The keel of the boat was laid on cross beams several feet above ground so that the planking could be easily put on. When it was ready for launching the pier shown in the picture was constructed of planks tied together and to the supporting posts by bamboo splits. Then bags made of coarse grass were filled with sand and stacked under the boat. The cross beams and other supports were knocked away, and then four men, two on each side of the boat, cut open the bags and as the sand poured out the boat settled slowly and comfortably down upon the pier. The boards underneath the three large cross beams were greased with coarse beef fat, and a half dozen men, by means of block and tackle, easily hauled it down the pier, where it was readily floated when the tide rose. Some of the bags of sand may be seen in the picture under the boat where it rests waiting for the incoming tide. By extending the pier the boat could have been launched directly into the water.



Home-made gasoline traction truck.

The "Stone Forest" of California

CALIFORNIA, among many other natural wonders, contains a "Stone Forest." This is located in Sonoma County, only a few miles from the little resort of Calistoga Springs. This "forest" consists of a great many petrified trees—all of which are prostrate.

In respect to the great number of petrified trees, and their immense size, the California "stone forest" surpasses that of Arizona. Strange to say, but very little is known about these wonderful Sonoma County petrifactions—so far as the general public is concerned. Many of these trees are of enormous size. The famous "Queen of the Forest" is a prehistoric redwood, about 80 feet long, and nearly 12 feet in diameter. It has been broken in several places, and these breaks are as clean as if cut off with a saw. A tree has grown up through one of the breaks and has attained quite a large size. Another giant tree known as the "Monarch" lies near by, which is almost 90 feet long and is without a break. This tree is a fir, and averages 10 feet in diameter. Not far away is another giant son of the forest—a redwood that is about 60 feet long and 9 feet in diameter. This tree is broken into many hundreds of pieces, yet it retains its shape almost perfectly. Scattered about for the area of several acres are many other pieces of petrifaction. So perfect has been the transmutation into stone, that the grain of the wood still remains very clear and the variety of the tree may be easily determined.

Home-made Gasoline Traction Truck

THE accompanying illustration shows an interesting home made traction truck designed at Shiloh, Ohio and utilized for sawing wood, grinding feed and pumping water. It is equipped with a 2½ horse-power two cycle gasoline motor provided with a throttling governor and weighs only about 200 pounds. It was built for portable power service, the equipment being arranged for moving the engine by its own power from place to place.

For pumping water the power is supplied by a pitman head on the rear of the truck, the pump being operated by a part of the same gearing that is used for driving the machine. The propelling chain is disconnected by a clutch when the engine of the tractor is used for pumping or similar service. The designer, A. E. Cross, is adding a rotary force pump mounted on the machine to be used for spraying trees and washing buggies. An equipment is also being provided for operating a power sheep shearing rig, so that a great variety of work can be accomplished by this unique outfit.

As may be observed in the accompanying engraving, the truck is fairly powerful for its weight and capable of climbing rough and steep grades.

The Inventor's Department

Simple Patent Law; Patent Office News; Inventions New and Interesting

Oddities in Invention

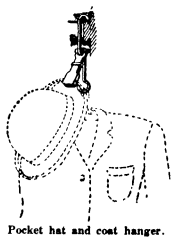
Potato Pick-up.—An ingenious device for picking up potatoes which have been harvested by digging with the machine or by hand is shown in the accompanying engraving. It consists of a scoop attached to a handle and provided with a rake adapted to draw the potatoes into the scoop. The scoop comprises a mouthpiece and a basket. It is attached to the handle by means of a pair of links and the rake is attached to the scoop by



Potato pick-up.

means of two links. When the device is supported by the handle it assumes the position shown by full lines in the drawing, but on pressing the handle forward the weight of the scoop is supported by the ground and the parts take the position shown by dotted lines in the drawing, from which it may be seen that the potatoes are drawn by the rake up the mouthpiece and into the basket.

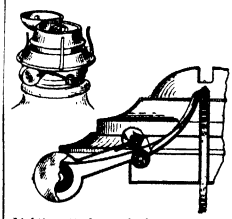
Pocket Hat and Coat Hanger.—For the use of travelers and for those who may find it necessary to hang up a hat and coat in a place not provided with a fixed rack, a simple pocket device has been invented. This may be secured to the molding of a door or to any projecting part. The device consists of a prong bent over and provided with a pointed



Pocket hat and coat hanger.

end whereby the device may be attached to a support. Extending from the prong is a hook on which the coat may be hung. This hook is made in the form of a button hook, so that it may be used for buttoning shoes if desired. To hold the hat, a clasp hanger is provided consisting of a pair of spring arms which may be closed on the rim of a hat and be held by a loop or like retainer. When not in use the device may be folded into a small compass and carried in the vest pocket.

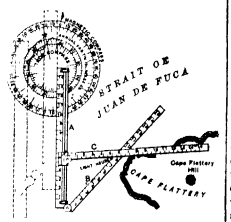
Lamp Igniter.—The lighting of kerosene lamps is usually quite a bother for the reason that the lamp chimney must be removed, and if this is hot it is necessary to wait for it to cool down in order to facilitate the lighting of the lamps. An inventor living in Colorado has devised a scheme by which the ignition may be accomplished by merely turning a thumb screw. An igniting strip is used, in the form of a roll, which is fed from a casing to the wick of the lamp. In the process of feeding the strip to the wick, it is dragged across a roughened surface that ignites the strip so that it is carried aflame to the wick.



Lighting attachment for kerosene lamps.

The accompanying drawing shows the mechanism quite clearly. The igniting strip is provided at intervals with protuberant ignitable heads. The scratching element which ignites these heads by friction bears against the upper surface of the strip immediately over the feed roll. The main body of the strip is incased in a heat-proof compartment so that there is no danger of setting it afire with the heat of the lamp. One of the advantages of this construction is that it may be used in connection with a lantern to ignite the wick in windy places where a match cannot conveniently be used.

Instrument for Determining a Ship's Position in a Fog.—Hertzian waves travel 186,330 miles per second; sound travels 1,123 feet per second in air, at ordinary temperatures, and 4,593 feet per second in sea water. If a lighthouse should send out a sound signal simultaneously with a wireless telegraph signal it would be possible for a ship to determine its distance from the lighthouse during a fog by noting the time interval between the sound and wireless signals as they reach the ship. If after an interval the ship has moved a certain distance as measured by the log in the usual way, and its distance from the lighthouse is determined again, by noting the interval between the sound and wireless signals, we have the three sides



Instrument for determining a ship's position in a fog.

of a triangle, with the lighthouse at one point, and the two positions of the ship at the other two points. A simple instrument has been devised for laying off this triangle on a chart, so as to fix the position of the ship. It consists of a graduated scale *A* with two graduated arms, *B* and *C*, secured thereon, the arm *C* being capable of sliding motion along the scale. The instrument can be set so as to form a triangle with the three sides proportionate with the triangle determined by the signal observations. This may now be laid upon the chart with the graduated scale lying in the direction of the ship's course as indicated at *A*, and the junctures of the two arms *B* and *C* at the lighthouse, when the position of the ship will appear at the junction of arm *C* and the scale *A*.

Shoe Button Remover.—A simple device has been invented which may be applied to an ordinary pair of shears to facilitate the removal of shoe buttons. This device, as shown in the accompany-



Shoe-button remover.

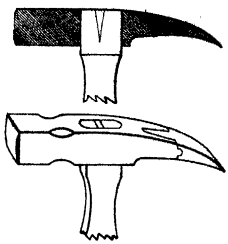
ing illustration, consists of an extra blade that is forked and slightly bowed. It is attached to the shears by means of a pivot bolt and a pin that serves to make the connection rigid. In use the forked blade is slipped under the button, serving to draw it away from the material so that the blades on the shears are in the right position to sever the threads without danger of cutting the material and with no liability of coming in contact with the metal shank of the button. When it is desired to sharpen the shears the attachment may readily be removed.

Combined Mop Head and Wringer.—The task of wringing out a mop is so disagreeable that many devices have been invented for performing the operation mechanically. Instead of providing a separate wringer to be used with the mop, an inventor has recently hit upon the idea of constructing the mop in such a way that it constitutes a wringer as well. The accompanying illustration shows the mop in section. As may be seen it is composed of two principal parts, one a central shaft with a collar secured thereon, and the other a sleeve mounted so that it can turn on the shaft. The mop proper consists of yarn looped from the sleeve to the collar in such a way as to form a double walled cylinder. The yarn is applied in a continuous length, being held in place by means of wire which encircles the sleeve in one case, and the collar in the other, being firmly clamped thereto. The mop may be used in the ordinary way, and when it is desired to wring it the sleeve is held in one hand and the handle of the mop is rotated therein, causing the yarn to be twisted and wrung out thoroughly.



Combined wringer and mop.

Improved Bricklayer's Hammer.—That part of the bricklayer's hammer with which the bricks are chipped off, and which is known as the peen of the hammer, is liable to wear out before the rest of the hammer does. For this reason an inventor has devised a hammer in which the peen is made readily removable. The way in which this is done is clearly shown in the illustration, a locking joint being provided between the peen and the hammer which will stand the thrust when the peen is in use. The peen may be made of high carbon steel so that it will wear for a great length of time, while the rest of the tool may



Hammer with detachable peen.

be made of an inexpensive low carbon steel. When the peen wears out it may be detached quickly and replaced with a new peen.

Adjustable File Handle.—The accompanying engraving illustrates a handle for files which is adaptable to files of different sizes and may be readily applied or removed. It holds the file by the tang in such a way as not to project

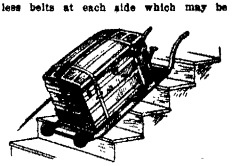




Adjustable file handle.

below the operating surface of the file. This permits of using the file perfectly flat, which in the majority of cases is of great advantage. The clamp by which the file is attached to the handle consists of two jaws that can be locked and tightened upon the tang of the file by means of a wedge. This in turn is held in place by means of a set screw.

Hand Truck for Stairways.—In order to facilitate the transporting of trunks up and down stairways, as well as upon level surfaces, a hand truck has been provided which in addition to the usual wheels in front, is provided with endless belts at each side which may be



Hand truck for stairways.

used as running surfaces in the manner shown in the illustration. The belts are supported at frequent intervals by rollers and bearing blocks. When moving the trunk up or down a stairway, the wheels clear the steps, but the belts

against the sinking of the treads. Felts prevent any possible marring injury to the woodwork and they may be employed, as well, on level surfaces that are not carpeted if it is desired to prevent marring the floor.

Edison Giant Roll Patents Sustained

AN important decision has just been handed down by Judge Hazel in the United States Circuit Court of the Western District of New York in a suit against the Allis-Chalmers Company and two of its customers, the Empire Limestone Company and the Casparis Company, on Edison patents Nos. 672,616 and 672,617, granted April 23rd, 1901, on the so-called Giant Rolls. These rolls are referred to in the recent book, "Edison: His Life and Inventions, by Frank L. Dyer and T. Commerford Martin":

"No such departure was as radical as that of the method of crushing the ore. Existing machinery for this purpose had been designed on the basis of mining methods then in vogue, by which the rock was thoroughly shattered by means of high explosives and reduced to pieces of one hundred pounds or less. These pieces were then crushed by power directly applied. If a concentrating mill, planned to treat five or six thousand tons per day, were to be operated on this basis the investment in crushers and the supply of power would be enormous, to say nothing of the risk of frequent breakdowns by reason of multiplicity of machinery and parts. From a consideration of these facts, and with his usual tendency to upset traditional observances, Edison conceived the bold idea of constructing gigantic rolls which, by the force of momentum, would be capable of crushing individual rocks of vastly greater size than ever before attempted. . . . He proposed to eliminate the slow and expensive method of breaking large boulders manually and to substitute therefor momentum and kinetic energy applied through the medium of massive machinery which, in a few seconds, would break into small pieces a rock as big as an ordinary cottage piano and weighing as much as six tons. Engineers to whom Edison communicated his ideas were unanimous in declaring the thing an impossibility; that it was like driving two express trains into each other at full speed to crack a great rock placed between them; that no practical machinery could be built to stand the terrific impact and strains. Edison's convictions were strong, however, and he persisted."

Judge Hazel, in referring to the patents under consideration and in setting forth a judicial review of Edison's accomplishment, said:

"Mr Edison's object was to devise a method by which massive rock or boulder when taken from their bed could be instantaneously crushed or broken into pieces at the least possible expense by the blows of large projections on the rollers and thus to eliminate the hand sledging or blasting of the prior art. To accomplish his object it was necessary that the rollers correspond in weight and strength to the size of the material to be broken up. He believed it possible to use the energy and force generated by the inertia of revolving objects. The problem was how to apply such energy to assist in the crushing operation. Kinetic energy is the term by which such force and power is technically known. The skilled engineer knew that a heavy rotating object contained stored power and energy component with it, and in the adaptation of such force and power for breaking and crushing large rock, it will be comprehended that if such energy could be practically used an achievement of great economic value and benefit in this art would result. It was necessary to design and construct machinery and rollers of a peculiar kind together with facilities for placing and using them in accordance with the methods operated and specified in the patents in suit. The patentee surmounted all obstacles and the record shows there were many. He was the first to evolve a crusher by which kinetic energy became a potential factor in the method of crushing and breaking rock by blows from the knobs on rollers. It scarcely can be doubted that his inventions are meritorious and involve in their organization and perfection patentable skill of a high order."

The court then refers to the claims of the two patents, one covering broadly the method involved in crushing rock by kinetic energy and the other relating to the apparatus employing the two massive rolls which are so driven as to permit the crushing and breaking to take place. It was urged in defense of the suit that crushing rolls of much smaller size had been made, assembled, geared together, and that no invention would be required to increase the size and weight of such rolls and to dispense with the gear so as to permit the rolls to operate independently. Concerning this defense, Judge Hazel said:

"A number of patents for crushers having rollers are claimed by defendants to anticipate and limit the claims in controversy, but such patents are inapplicable. To bring together and adapt in dimensions, iron rollers of such large proportions inclosed in a frame and providing means for periodically storing kinetic energy and periodically expending it as described in the specifications, was invention of the highest merit. It was not simply a question of changing the proportion, size or shape of the rolls. New and novel additions in crushing apparatus were made. The prior crushing or pressing rolls contained no helpful suggestions to the patentee as to the manner of using kinetic energy to instantaneously fracture heavy rock. Although the prior art shows crushing rolls with irregular surfaces, yet such rolls were geared together and were not driven by a belt in opposite directions. They were incapable of delivering blows to powerful rock masses. Indeed there is a total absence in the prior art of the use of kinetic energy to secure the hammering action necessary to break such heavy material as contemplated by Edison's invention. . . . In the prior art there is not disclosed any method or apparatus for breaking rock by the medium of crushing rolls which are provided with knobs or projections and are driven by belting. They were provided in most instances with teeth or projections and the rolls which were geared together and their function was to compress, pinch or pick the material to separate the particles. The driving agent apparently performed the work of crushing the material while in the patents under consideration there is a distinct departure, the material being wholly crushed or broken by the energy of the knobs on the rolls. Although some of the separate elements of the claims in controversy were old and are found in the prior apparatuses, yet such old elements had never before been assembled or combined to use power stored in the rolls to break or crush rock nor prior to the inventions in suit had such rock been broken or crushed by hammer blows from projections on the rolls driven by belt and rotating in opposite direction. It is not enough to select separate elements from different devices and then without making any patentable change or improvement insist, as do the defendants, that the patented structure might have been similiarly constructed. The claims are entitled to such a fair construction as will preserve to the inventor the fruits of his discovery."

The defendants structure was held to be an infringement. On this subject the court said:

"To summarize, the defendants' rolls in operation are substantially the same as those of complainant, having a like capacity for crushing rock; they use the kinetic energy to break the material periodically dumped upon the rolls and their operations perform the functions of the patents in suit and achieve the same result. The method patents describe the mode of treatment of the rock by which it may be shattered and the series of steps to be taken in the transforming process.

"The combination of elements by which the splendid results of breaking rock by blows due to the use of kinetic energy were attained undoubtedly involves the exercise of invention as distinguished from mechanical skill. The prior art neither suggests the patentee's method nor the apparatus by which the work could be done."

How I Invented the Air Brake—III*

By George Westinghouse

THE next event of importance was the application of the brakes in November, 1869, to a longer train of ten cars upon the Pennsylvania Railroad, which was taken to Philadelphia for the purpose of demonstrating to the directors of that railway the success of the apparatus. I may say at this point that the Pennsylvania Railroad had been using for some years a chain brake similar to the one applied by Mr. Ambler, but had found that its use was limited to short trains and that it was not a satisfactory contrivance for the purpose intended. There were invited to witness these trials in Philadelphia a large number of railway people, and the papers gave extended notices of the tests made, which brought to the train on the next day Mr. George L. Dunlop, the general superintendent of the Chicago & Northwestern Railway, who was desirous of having the whole apparatus fully explained to him. The result of this inspection of the air brake apparatus was an invitation to make a demonstration upon his railway in Chicago, and he offered, if the Pennsylvania Railroad would send a train for the purpose, to invite the leading railway people and members of the press of that vicinity. The apparatus was then transferred to a train consisting of a new locomotive and six new cars, and this train was run to Chicago over the Fort Wayne Railroad, and a number of tests were immediately afterward made upon the tracks of the Chicago & Northwestern Railway, evidently to the entire satisfaction of those present. From Chicago, the train proceeded to Indianapolis, where other tests were made, and then back to Pittsburg.

The outcome of these demonstrations was immediate orders for equipment for the Michigan Central and the Chicago & Northwestern, and shortly after for the Union Pacific Railway in the West, and for the Old Colony and the Boston & Providence roads in the East.

I refer to these details to illustrate the readiness with which railway officials took up this invention and the comparative ease with which the required orders were secured, and because it has been often stated that the trials and tribulations in the introduction of the brake were of the severest nature.

Works were built in Pittsburg for the manufacture of the apparatus and were fitted with the best tools obtainable. Standards were adopted and adhered to in the parts of the apparatus which required uniformity in construction in order to insure interchange of the rolling stock so fitted upon various roads. I think I am safe in saying that the course pursued in the manufacture and introduction of the brake had a more important bearing than anything else in deciding the railway master mechanics and master car builders a few years later to take up the question of the standardization of various parts of cars in order that repairs could be more conveniently made.

It soon developed that it took considerable time to apply the brakes with full force and a longer time to release them, and that in the event of a break-in-two of a train (a frequent occurrence in those days) the rear section would be uncontrolled, and when this occurred upon an ascending gradient, the rear detached section might run away, with disastrous results. To overcome this difficulty a new development was necessary, the outcome of which has since been known as the automatic air brake.

In the automatic air brake equipment there were the same air-pump, reservoir, train pipe and brake cylinder, but in addition to these there were two important features added to the tender and each car equipment, the first, an auxiliary reservoir, and the second, a triple valve or device interposed between the brake pipe, brake cylinder and auxiliary reservoir. This triple valve was so constructed that when air was admitted to the train pipe, an opening was established between the train pipe and the auxiliary reservoir whereby the train pipe and reservoir were filled with air under pressure. The valve also opened a passage from the brake cylinder to the atmosphere. This was the normal condition of the apparatus when the brakes were off. To apply the brakes, the engineer discharged a portion of the air from the train pipe, whereupon the triple valve closed the connection between the brake pipe and the reservoir and between the brake cylinder and the atmosphere, and then opened a passage from the auxiliary reservoir to the brake cylinder, the piston of which was moved outwardly by the air from the auxiliary reservoir so as to apply the brakes. The restoration of the pressure within the brake pipe released the brakes and recharged the reservoir. This development occurred during 1872 and 1873.

The automatic brake was at that time supposed to be instantaneous in its action in applying the brakes, and almost instantaneous in releasing them. In the event of the escape of air from the train pipe by its rupture or by the separation of the train, the air stored in the auxiliary reservoirs instantly and automatically applied the brakes to all parts of the train and they could only be released by either repairing the damage and restoring the pressure, or by means of special release valves operated by the train men.

The automatic brake having proved itself vastly superior to the plain or straight air brake first described, it soon became a standard, but during the transition period an automatic brake was easily converted into a plain brake by a manually operated special valve arranged in the casing of the triple valve.

The gradual increase in the length of freight trains and the numerous accidents due to lack of brake control early suggested that automatic air brakes should be made a part of the equipment of all freight trains, and to determine the practicability of the automatic brake for this purpose a train of fifty cars was fitted in the early eighties and taken over the Alleghenies on the Pennsylvania Railroad, and the tests made demonstrated that such a train could be controlled on the heaviest gradients by this means.

In 1885 the Master Car Builders appointed a committee to report upon the feasibility of the application of brakes to freight trains, and this committee inaugurated what are now known as the Burlington (Iowa) brake trials, made in 1886 and 1887. There were presented two trains fitted with air brakes, one fitted with a vacuum brake and one with the brake operated by means of attachments to the drawbars similar to the conception first referred to. Each of these trains had fifty cars. These tests proved the inadequacy of the type of automatic air brake then presented by the Westinghouse Air Brake Company, as well as the inadequacy of all the other brakes then tested.

It becoming apparent that the lack of success at Burlington was due to the comparatively slow application of the brakes upon the rear portion of the train, the effect of which was to cause most serious shocks almost like collisions, a new development was imperatively needed in order to insure the successful handling of freight trains of fifty cars.

As a part of the automatic air brake passenger equipment, I had developed in the seventies a system of train signaling involving the use of a second train pipe, which is now in general use upon all of the railways. This signalling apparatus had a sensitive valve device connected to a small reservoir upon the locomotive, and these were so arranged that when compressed air was admitted through a small opening into the signalling pipe, both the pipe and reservoir were charged to a low pressure (at the present time to forty-five pounds). By opening a valve at any point in the train to permit a small quantity of air to escape from the signal pipe, the delicate valve referred to was caused to move so as to admit air from its auxiliary reservoir to blow a whistle located in the cab of the locomotive. It was found upon experimentation that when the valve in any car remote from the engine was quickly opened and closed as many as five times, the whistle would be blown an equal number of times, the first time being after the last escape of air, that is to say, there were set in motion five distinct waves of air, each capable of doing work.

During these developments it was found that the waves of air within the brake pipe traveled as rapidly as sound, i. e., about 1,100 feet a second.

(To be continued.)

* From Presidential Address presented at the Annual Meeting of the American Society of Mechanical Engineers.

Legal Notes

A Bad Patent Bill.—Representative Oldfield member of Congress from Arkansas, and chairman of the House Committee on Patents, introduced on May 5th, 1911 a bill (H R 8,776) to amend Section 4,886 R S to include provisions for compulsory licensing upon the order of the Commissioner of Patents and for the determination of the patent if such order be made and not complied with within a time limited The bill also contains a Section 2 which is entirely independent of the compulsory license feature, and reads as follows

"Sec 2 That all patents of improvement of any new and useful art, machine manufacture or composition of matter shall in no event operate to extend the life of the original patent, but such patent on such improvement or improvements shall expire on the date of the expiration of the original patent "

There is little prospect of any patent legislation being effected at the present session of Congress, and doubtless full hearings will be accorded by the Patent Committee on the foregoing bill, before any report is made thereon to Congress It requires but a casual reading of the bill to appreciate how detrimental it would be to the inventive public as well as to the public generally in stifling invention limiting the opportunity of the inventor to properly control and profit by his invention and retarding the great commercial and other progress which necessarily results from the development of the arts by the exercise of invention under the fostering influences of the patent laws of to-day

This idea of compulsory license is not a new one to Representative Oldfield, who introduced the new bill, for he was on the Patent Committee of the Sixty-first Congress, and he doubtless remembers the able arguments in opposition to the license proposition advanced by learned counsel at the hearings in the winter and spring of 1910, particularly that of Mr Frederick P Fish of Boston On the constitutional phase of the question, Mr Fish speaks with great force, saying

"The Constitution of the United States, with wonderful foresight, as I look at it, says that Congress shall have the power to reward the inventor and to promote the useful arts by giving him the exclusive right for a limited time What does that mean? It means what it says, the power to give him an exclusive right, not the power to give him some other kind of right, and the courts have so construed it I question the constitutional power of Congress to interfere in this matter It can make no difference whether you deal with the inventor or the assignee If you give the inventor the exclusive right, that is one of the things he sells to the assignee If the law is changed so that he is obliged to say 'I cannot give you the exclusive right, of course, because Congress has passed a law saying that at any time or at some time certain things may happen to take it away from you'"

Again, on this point, Mr Fish said, "In view of the invariable construction that has been given to the Constitution down to the present day, and in view of the conditions of the English law at the time our Constitution was established I think the Court ought to say— I don't know what they would say— that when the Constitution said 'exclusive right' it meant that and nothing else That is, the exclusive right to make, sell, and use, as the statute states it, and the courts have so construed it, because the Constitution required it But that is only my view, and I hope that it will never get to the point where the constitutional question will have to be raised."

As to the practical effect of compulsory licenses Mr Fish said:

"Compulsory license would be fatal The whole patent system of the United States would be demoralized. The industries of the United States have a hard enough time ahead of them for several years to come and if we lose the merit of our patent system, I don't know what would happen. The whole stimulus now existing for the development and improvement of industries would in my judgment be shaken to the foundation if there should be any interference with that particular phase of the situation by which for a short time—so short, as I say, that half of it is wasted in the case of nearly every good patent—a patentee has the absolute control of his invention"

Notes for Inventors

A Machine for Selling Luncheons.—The popularity of quick lunches attracts attention to a patent for a dispensing machine, patent No 994,717, to Frederick O Bullis of Rochester whose machine automatically delivers a portion of food and provides for automatically measuring a portion of condiment as the food is delivered, while the delivery of the condiment is under the control of the operator

Pipe Holder.—Pipe smokers will find some comfort in an attachment for smokers' pipes which Howard Elliott of Washington, D C, presents in a patent No 994,913 It is a small, neat affair, having a clamp by which it may be spring-held on the stem of a pipe with a projecting plate forming a rest to support the pipe in an upright position on a table or stand, the projecting pla also forming a means for hanging the pipe up on a hook or nail when not in use

Enriching Coffee.—To improve the quality, soften the flavor and enrich coffee is the stated object of a patent, No 994,785, to Ellis M Potter of New York city He seeks to accomplish these objects by mixing green chicory root with the green coffee bean or berry and roasting the mixture, the coffee being subsequently separated from the chicory

Driving Devices for Gas Engine Fans.—In patent No 994,764, assigned to Gilbert J Loomis of Erie, Pa., the theory is applied that when the engine is running with a light load but with a high speed, the cylinder radiator or condenser is not so highly heated as when the engine is running slower. With a higher load, the invention provides means for automatically varying the relative speeds of the fan and engine so that the fan may be given a maximum velocity with the low speed of the engine and this velocity is so varied as the engine is speeded up as to keep the velocity of the fan within the limits of safety

New Explosive.—The E I Du Pont de Nemours Powder Co is the assignee of the patents 994,841 and 994,842 for inventions of Harrold Hibbert of Wilmington Del, in explosives including butylene glycol nitrate alone and in connection with nitrates and nitro compounds

A Westinghouse Patent.—George Westinghouse of Pittsburg has just patented No 994,810, cooling and ventilating means for electrical apparatus in which a system of fluid passages having inlet and delivery ports are combined with rotary and stationary parts and the velocity of flow of fluid through the passages is affected by the withdrawal of the fluid from the delivery ports

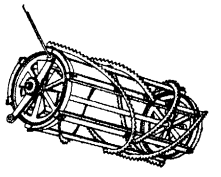
A Pocket Ink-stick.—Fountain pens are widely used and Harry N. DeLanoy of Nelsonville, N Y, has patented No 994,724, an ink stick or cartridge which can be conveniently carried in the pocket and cleanly handled and will render the use of a filler unnecessary. The cartridge is in the form of a porous splint whose surface film is of a coloring substance soluble in water and is formed of a dry powder adhering to the surface of the splint.

RECENTLY PATENTED INVENTIONS.

These columns are open to all patentees. The notices are inserted by special arrangement with the inventors. Terms on application to the Advertising Department of the SCIENTIFIC AMERICAN.

Of Interest to Farmers.

MANURE SPREADER.—George W. Barnard, Economy, Ind. This invention relates to manure spreaders in which the material is distributed from a wagon by means of a distributing cylinder or beater. The cylinder is shown in perspective in the engraving The purpose is to provide a distributing cylinder which will be simple in construction and



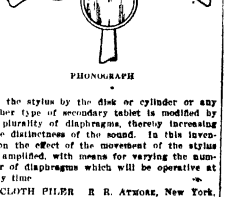
MANURE SPREADER.

reliable in operation, the distributing cylinder being so constructed that it will not only separate and practically pulverize the manure, but will scatter the same broadcast over a greater area than that occupied by the machine Patents in this case are pending and to be taken out in Canada, Great Britain, Germany and other foreign countries.

TOOL W J Strealy, Lewisburg, W. Va An object in this invention is to provide a device which ordinarily can be carried by inserting the handle thereof on the pole of the reaper or mower, and which, when it is desired to use the same, can be readily clamped onto the wheel of the machine and utilised to great advantage

Of General Interest.

PHONOGRAPH SEPTIMUS T. E. White, 308 W 3rd St., Oklahoma, Okla., and John E White, New York, N Y A fragmentary plan view is illustrated in the engraving, in which auxiliary sounding boxes are shown connected in multiple with the primary sounding box The invention relates to an improvement whereby the effect of the vibrations imparted



PHONOGRAPH

to the stylus by the disk or cylinder or any other type of secondary tablet is modified by a plurality of diaphragms, thereby increasing the distinctness of the sound. In this invention the effect of the movement of the stylus is amplified, with means for varying the number of diaphragms which will be operative at any time

CLOTH PILER R R. Athore, New York. N Y The aim in this invention is to provide, in connection with a table and a reciprocating carriage and track for supporting the same for the purpose of laying the fabric on said table in superposed folds, a guide or set of guides for properly positioning the fabric as it is being laid

LOCK BEAM TUBE.—P. H. Frim., New York, N Y This improvement provides means for interlocking the various layers of metal wherefrom the completed tube is constructed in a form wherein the joined ends of each layer are prevented from spreading by the body structure of the other layer; and provides a tube constructed of a series of layers arranged to form a continuous wall having an even thickness.

IRRIGATING SYSTEM.—J. T. Donahoo, Edgar, Neb. An object here is to provide a system which may be successfully employed in those valleys in which there is a stream of water at whose level the land of the valley is more or less wet Another is to provide a system in which lands at some distance from the stream may be irrigated without the necessity of making ditches or canals leading from the stream itself.

Miscellaneous Devices.

SAW GUIDE.—C. Hammond, Mt. Pleasant, Colo. This invention relates to saw guides and is adapted to be quickly set and adjusted to hold a saw steadily and accurately in position as it cuts into the log, so that the cut can be commenced at all times. The guide is made of a support for clamping it to the tree, and a series of adjustably connected supports, and a saw guide member mounted on one of the supports and adjustable to slide in the guide.

WRENCH.—Lorenzo E. E. Schuster, Minot, N. D. This invention relates to wrenches, and the more particular purpose is to provide a tool of this general character suitable



WRENCH.

use either alone as a hand instrument or in combination with a rotary brace. More particularly stated the invention shows in the engraving provides a wrench having a two-part shank adapted to be bent and used as a handle or to be straightened and put into a brace, the tool further comprising various portions whereby it is adapted so be used as an alligator wrench, a monkey wrench, or a socket wrench.

CLAMP.—S Adell, Orange, Mass. In this case the invention provides a clamp for reliably clamping articles of various dimensions and proportions. Use is made of handled clamping screws, having clamping bars operatively mounted thereon, with means in one of the bars for screw threadedly engaging the clamping screws and means in the other clamping bar for preventing the said bar from sliding longitudinally on one of the clamping screws.

Household Utilities.

WINDOW CLEANER—John W. Gibbons, 2725 Jackson St., Baker City, Ore. The invention illustrated by the engraving relates to a device for cleaning windows or the like, which



WINDOW CLEANER.

is in the form of a flexible pneumatic wiper that is adapted to be rotated by a suitable source of power at any suitable angle An object is to provide a cleaner with a buffer, and means for tilting the buffer to various angles with its support; to provide a flexible pneumatic buffer with means for tilting the same from the source of power, and with means for automatically disconnecting the tilting means from the source of power when a predetermined position of the buffer has been reached; and to provide a cleaner which may be adjusted at to its length within friendly reach of the source of power.

[illegible]

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Inquiry No. 6944.—Wanted, addresses of parties who manufacture or use [illegible] for [illegible].

Inquiry No. 6945.—Wanted, to buy a [illegible] machine.

Inquiry No. 6946.—Wanted, the name and address of a [illegible] who can [illegible] a patent rolling machine which will [illegible] and [illegible] at the same time.

NEW BOOKS, ETC.

DICTIONARY OF AVIATION. By Robert Morris Pierce. New York: The Baker & Taylor Company, 1911. 287 pp. Price, $1.40 net.

In his preface Mr. Pierce tells us that it has been his attempt "to produce a word book for the use of persons interested in aviation from any of the various points of view from which it may be contemplated, or from any of the starting points from which it may be pursued." That he has succeeded in this attempt, even the most cursory examination of the book must prove. In the effort to be complete we find many a curious compound which has unnecessarily swelled the volume of words. Thus we find such unnecessary combinations as "aeroplane-accident," "aeroplane-experiment," "aeroplane-flight," "aeroplane-owner," "aeroplane-race," "aeroplane-term," "aeroplane-tower," and "aeroplane-work." Compounds such as these may be produced almost by the hundred. Perhaps that explains why this dictionary contains no fewer than 4,276 title words and phrases. In the definition of a helicopter, we are told that such machines depend "for lifting or sustaining power upon vertical screws or rotating air foils," where evidently a horizontal screw is meant.

THE NEW INTERNATIONAL YEAR BOOK. New York: Dodd, Mead & Co., 1911. 837 pp.

Among the noteworthy features of this year's International Year Book, which may well be regarded as an annual encyclopedia, are politics, current history, and biography. Subjects such as the referendum and initiative, conservation, municipal government, banks and banking, strikes and lockouts, arbitration, in other words, subjects which have occupied considerable space in the public press during the past year, are treated with commendable fullness. On the other hand, we find the division or aeronautics rather one-sided. The developments in aviation are summarised well, considering the limitations of space, but the development of the dirigible, which has been truly remarkable, is limited to a description of Wellman's "America," the Zeppelin airships, the Willows dirigible, and the "Clement Bayard II," notwithstanding the fact that the Parseval has made wonderful records, and that almost every military power of Europe has for two years past been engaged in the building of dirigibles. The article on astronomy is good. As is natural, considerable space is devoted to Halley's comet. It is no longer seriously thought by astronomers that light pressure is the sole cause of the phenomena of the comet's tail. More space should have been devoted to the discussion of new stars. The topics under the head of physical chemistry seem to have been rather arbitrarily selected. Considerable space is devoted to radium paper and fiber, artificial rubber, permutite filtering, but no space at all to the industrial application of the new coal-tar dyes, perfumes, and the like. Achievements in electro-chemistry and electro-metallurgy, in which new events may be recorded almost from month to month, find no place whatever in the Year Book, though some curious oversight. Indeed, in science and engineering the Year Book seems to be weakest, and it is just here where it should be at least as strong as in other portions. This criticism made we should not militate too seriously against the book for there can be no doubt that as a piece of painstaking compilation of happenings during the past year it will prove a valuable reference book.

A CONCISE HISTORY OF CHEMISTRY By T. P. Hilditch. New York: D. Van Nostrand Company, 1911. 268 pp. Price, $1.25.

Considerable interest is being manifested at the present time in the history of arts and science. It seems indeed as if no rational person, living in this age of the most remarkable scientific achievements, could remain in perfect indifference, never giving a thought to the inquiry after the origin and growth of this wonderful element of our civilization. To the student of science, some familiarity with the history of his subject is indispensable for a thoroughly intelligent grasp of his work. It is true that perhaps the best mode of acquiring this familiarity is through the consultation of the original publications. The process of thus imbibing historical knowledge is, however, slow, and for the most part falls into the period of a man's life work rather than into his college years. For reading to be carried on concurrently with the younger student's regular work, such a hand book as the one before us is eminently desirable. The author gives a brief but very excellent survey of the principal phases of the history of chemistry. The text is divided into eleven chapters, under the following headings: I. The Evolution of the Science. II. The Chemical History of Fire, Air, and Water. III. The Ultimate Constitution of Matter. IV. Inorganic Compounds and the Laws of Chemical Combination. V. Notes on the History of the Elements and their Chief Compounds. VI. The History of Organic Chemistry. VII. Compounds and Reactions in Organic Chemistry. VIII. The Chemistry of Plant and Animal Life. IX. The Application of Chemistry to Manufactures. X. The History of Physical Chemistry. XI. The Progress of Experimental Method. There are two appendices, the first giving a biographical index of the great chemists, a brief résumé of the man's most important contributions to science being given under each name. The second appendix is a tabular summary, in chronological order, of chemical events of out standing interest. The book is one of more than ordinary merit.

MODERN GUNS AND GUNNERY. A Practical Manual for Officers of the Horse, Field, and Mountain Artillery. By Brevet Colonel H. A. Bethell, Royal Field Artillery, Woolwich. 1910. J. J. Cattermole, Wellington Street, 1910

This comprehensive and admirable work has been written for the use of officers who may be deterred from a study of some other text books because of the real or imaginary terrors of the mathematical demonstrations with which their pages are apt to bristle. While the designer of guns, carriages, and ammunition must have an exact mathematical knowledge of the science of gunnery, the officer who uses the gun need have no more than a clear understanding of the principles of gunnery to enable him to apply these principles in handling the guns. This work is intended first as an easily understood manual for those whose whole duty leaves them no time to master the difficult science of gunnery, and secondly it is intended as an introduction to the study of more advanced books. The last edition, written in 1904, has been thoroughly rewritten in producing the present work. The theoretical portion has been altered, the ballistic tables made more perfect, and some of the older theories have been modified by recent experience. The book is divided into four parts, consisting of "Theoretical Gunnery", "Principles of Construction of Guns, Carriages, and Amunition", "Practical Gunnery", "Sighting Quick-firing Equipments", and "Gunnery Calculations". It is sufficient to say that the author has succeeded thoroughly in his aim to be comprehensive and clearly understood. The work is abundantly and judiciously illustrated, and is one of the best of its kind that it has been our pleasure to review.

THE SEVEN FOLLIES OF SCIENCE. By John Phin. New York: D. Van Nostrand Company, 1911. 231 pp., 34 illustrations. Price, $1.25.

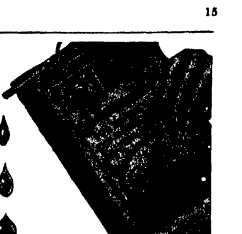
This is the second edition of a book which has deservedly found favor. The follies enumerated are: Squaring the circle, the Duplication of the Cube, the Trisection of the Angle, Perpetual motion, the Alchemical transmutation of metals, the Fixation of mercury, the Universal medicine and the elixir of life. These seven follies constituted practically all of the first edition of this book. In this second edition will be found discussions of perpetual or ever-burning lamps, the alkahest or universal solvent, palingenesy, the powder of sympathy, besides a number of paradoxes, illusions and marvels which should hardly find a place in this book, and which include the Fourth Dimension, How a space may be apparently enlarged by merely changing its shape. Can a man lift himself by the straps of his boots? How a spider lifted a snake. How the shadow may be made to move backward on the sundial. How a watch may be used as a compass, etc. We rather wonder, too, why curious arithmetical problems should have been included in this book. More appropriate is the discussion of such questions as the following: That most great discoveries are made by accident. That the idea of the steam engine was suggested by a teakettle. That whetstones are oiled to lessen friction. That lightning never strikes twice in the same place. That the first fire came from branches of trees moved by the wind. That volcanoes are burning mountains. That the force of dynamite is always exerted downward. That steam can be seen, etc.

THE OPEN BOOK OF NATURE. An Introduction to Nature Study. By the Rev. Charles A. Hall. New York: The Macmillan Company, 1911. 8vo., 288 pp., Illustrated. Price, $1.75 net.

Nature with an English background is here pictured in such a way that young readers will be led to identify the commoner forms of life, to name the birds and to know their eggs, to name the wild flowers and learn their well-loved nooks. There is a glossary which will prove very useful.

HOW TO USE THE ELECTRIC LIGHT WITH INCREASED ECONOMY AND EFFICIENCY. Including a Chapter on Electric Heating. By Frederick H. Taylor. London: Percival Marshall & Co. 76 pp. Price, 25 cents.

A simple instruction book for householders, shop-keepers, and factory owners. It contains enough good hints to make its perusal by the consumer of electricity well worth while, but it must be read with the understanding that it is written from the standpoint of the electrical industry and with reference to English conditions, which in many instances differ greatly from those of America.



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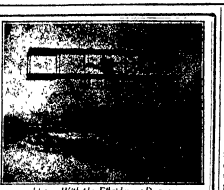
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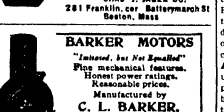
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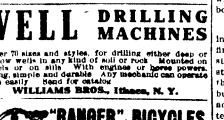


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Notes and Queries

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(12474) R. L. says: IN SUPPLEMENT No. 1217, in an article on liquid air, the statement was made that liquid air could be poured over the hands without producing much sensation, on account of the heat of the hand forming a thin layer of gas between the hand and liquid air How long could the hand remain submerged without being damaged? A. The hand cannot remain submerged in liquid air for any time without being frosen. It can be put into liquid air and taken out again without injury if this is done so quickly that the heat of the hand cannot be absorbed by the cold liquid Heat cannot pass out of the hand in an instant 2 I have read several different times that the strength of iron and steel was doubled (that at ordinary temperature) when cooled to the temperature of liquid air Now then, why is it that tools made of a high grade of steel, such as saws and hammers, break very easily when they are at that temperature called frozen? A. The tensile strength of iron becomes approximately doubled at the temperature of liquid air. Lead becomes elastic like steel. Iron and steel become very brittle at such low temperatures, and break like glass by bending Tensile strength and flexibility are not similar properties. 3. In their search for a motor seasonably immune from stopping, why don't the flying machine men use the steam engine, such as are used on some automobiles? A. The weight of the steam boiler and engine with its supply of water is against it Thus far no one has been able to construct a steam engine anywhere near as light as the gasoline engine. 4 I have heard that a man in a balloon reached a height of seven miles above sea level What is the atmospheric pressure at that height? Is the oxygen proportion the same as at sea level? A. The highest balloon ascent of which we have a record is 34,450 feet. The barometer stood at 7 95 inches This is something less than seven miles We have no record of the composition of the air at that elevation. The kinetic theory of gases would indicate that there should be less oxygen at that altitude than at the level of the sea 5 The SCIENTIFIC AMERICAN has stated many times that the highest temperature attained by man was the electric arc (estimated at 5,000 degrees) I have here a calculation that seems to contradict that statement. Take the case of the oxygen hydrogen combustion, allowing 50 per cent excess oxygen to make complete combustion more certain 1 cubic foot 12,000 Deg Fahr In the combustion of carbon-oxygen the temperature is still greater. I obtain 15,494 degrees total, considerably hotter than the oxygen-hydrogen combustion under the same conditions What do you think of this? A We are not able to assent to the assumptions upon which your determinations of the temperatures reached by various combustions are based. Your results could be true only if all the heat were received and retained by the resulting gases and if all the gas were heated uniformly throughout, and that instantaneously All of which is impossible to attain Your results may be called potential temperatures, but nothing more They are far from actual The impossibility may be realised from the statement that oxygen and hydrogen begin to dissociate at 2700 deg F. and have reached their limit at 4500 deg F. At a temperature of 12,000 deg F. a chemical action of oxygen upon hydrogen is impossible. They would remain perfectly inert in each other's society It is impossible to give figures for the temperature limit in the cases you present Kent, in his "Mechanical Engineer's Pocket Book," new edition, pages 786-6, gives a formula for calculating the temperature of combustion of materials containing carbon, hydrogen, oxygen, and water vapor But he says that the temperatures obtained by experiment are below those obtained by calculation, for which he gives certain reasons We send the book for $5

(12475) O. J. C. asks: We are occupying a steel concrete building here which was finished one year ago On the rear wall of our store room and basement we have had foil strips glued up and down on these walls, through which the current passes for the burglar protection Through either chemical action or moisture the current is at times interrupted that we cannot use the burglar protection, and the foil itself seems to have gone through a chemical process, so that it rubs off like powder Now what we wish to ask is if there is anything that you know of in the way of a thin covering that we can put over these walls so as to make them moisture-proof, and to which these foil strips can be attached, and work with satisfaction. A. A coating of shellac will render tinfoil moisture proof This is used in various electrical apparatus for this purpose, such as condensers, where it is very necessary to keep out the water. The shellac will act as a glue to make the foil adhere to the wall. The glue will not be necessary. The shellac is a good insulator also. Asphaltum varnish will serve the same purpose

(12476) H. O. S. asks: As I have always understood that any object that gives forth different tones by increased or decreased vibrations gives forth but one tone at any one instant or the smallest fraction of a second, will you kindly explain whether the reproducer of a talking machine, during a band selection, for instance, when several instruments are each making a different tone at the same instant, actually gives out the several tones at any instant, or apparently does so by the predominating tones following each other so rapidly in such a small fraction of a second that the ear is unable to realise it? A. The exact nature of the record in a talking machine is not clearly known. Much investigation has been spent upon it. Many papers have been published giving the reproductions of the tracings of the reproducers much enlarged. But the indentations are so minute and of so little depth, that very little progress has been made in this research. A very good report of this work may be found in the recent textbook of Sound by Prof. Barton of Nottingham. We will send the book postpaid for $2 It does not, however, answer your question. Perhaps the only certainty is that you actually hear the music of a band in the phonograph just as if you were listening to the instrument when the sound is directly transmitted through air. We are inclined to the opinion that the reproducer actually gives out the several tones just as they went into the recorder.

(12477) G. E. A. asks: How to find the specific gravity of water, and how to find out the difference in draft of a ship in salt water and fresh water. A. The specific gravity of fresh or pure water is 1. It is the material with which all other materials are compared, and hence is assumed as unity The specific gravity of sea water varies from 1 025 to 1 03, according to its degree of saltness A ship will displace the same weight of salt water as of fresh The fresh water would occupy the larger volume, and the ship would sink deeper in it. Taking the salt water as the usual medium for a ship to float in, and the volume of fresh water displaced by it will be 100/1000 of the volume of salt water displaced by it. As "draft" is the vertical depth from water line to lowest point of keel, the increased draft of ship in fresh water as compared with salt depends upon the shape of the ship One vessel might sink an extra inch and another a foot or two in fresh water By calculation from the hull drawings, marine engineers can determine the exact displacement of a ship at any depth of immersion. The weight of ship and cargo equals the weight of the displaced water. Therefore to move a ship from salt to fresh water changes its draft an amount equal to the change that would occur if the ship's total weight (including cargo) were increased by the specific gravity of salt water—1 025 to 1.03. In other words, it would draw as much more as if it were loaded an additional three per cent.

(12478) C. P. DuS. writes: Can you send me the alphabet commonly used in wireless service, with the name of an advertiser who will furnish me with an outfit? A. You will find the Morse and Continental alphabets used in the wireless telegraph in Collin's "Wireless Telegraph Handbook," which we send or $1 50. We must be excused from copying them when they are accessible in printed form.

(12479) P. W. B. asks: 1. What form of tuning fork, cylinder wire, or other mechanism, is the most sensitive to sounds produced by other means of a mechanical nature or the voice? A. A tuning fork mounted upon a proper resonant box, will take up and reproduce any sound of exactly the same period as its own, and so reproduce it. So too will a piano string, as you may prove by raising the loud pedal and singing a note into the piano. You will find several strings to be giving forth their tones, which are the overtones of your voice when singing that note. We do not know anything more sensitive than this. 2. Is there any instrument made, or how can I make, or have made an instrument that can be attuned to various sounds, as given on the piano, say, or on a harp, or violin? A. There is an instrument called the phonautograph which registers any tone spoken or sung into it. This you can learn about by addressing Queen & Co., 59 Fifth Avenue, New York. 3. What books are the best authority on acoustics? A. Sounds and methods of testing them out, or attuning other things to them? I am not up in this line, but am I a scientific man, other than from general reading but not from a mathematical standpoint, so something of a simple nature is apt to be of more value to me, and with this in mind, your reference will be gaged, if you please. A. The latest book on acoustics is Barton's "Textbook of Sound," which we will send for $3. It contains a chapter upon sound recorders and reproducers.

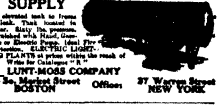
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Lithopone and Its Manufacture

By S. Rose

ATTEMPTS had long been made to manufacture a real white paint of high covering power from baryte, otherwise known as heavy spar, which has been used largely as an adulterant to other white pigments. The various attempts met with success both in Germany and England when the substance commercially known as lithopone was made. It has also since been known by its other commercial names, such as Orr's white, Jersey Lily white, ponolith, oleum white, and others given by various manufacturers. It is a chemical compound, the constituents being zinc sulphide 29.5 per cent and barium sulphate 70.5 per cent. When fairly pure, solutions of known strength and proper temperature of zinc sulphate and barium sulphide are mixed in their molecular proportions, a heavy flocculent easily filtered precipitate is obtained according to the formula:

$$ZnSO_4 + BaS + H_2O = ZnS + BaSO_4 + H_2O.$$

This precipitate, however, has very little covering power. John B Orr, of England, discovered that when it is heated to a dull redness and suddenly plunged in cold water and then thoroughly ground, washed, and dried, it is completely changed into a new substance, although with no chemical change, far excelling in its qualities most of the white paints. The cause of this change is not well known. It seems probable that this treatment causes an internal re-arrangement of the molecules. The different commercial samples vary in their composition to a slight extent, and the modes of the manufacture are kept as trade secrets. In recent years the quality of the substance has been much improved and made uniform. There is no difficulty or much complication in its manufacture, success depending to a large extent on the purity of the substances used and those again are more or less easily prepared. But the manipulation must be carried on with care and knowledge, as otherwise the result will be unsatisfactory and the presence of impurities will make the paint colored and totally unfit for the purposes for which it is used.

The barium sulphide is made in the following way: About 100 parts of finely powdered baryte and 20 parts of coal slack or charcoal, petroleum residue, pitch, sawdust, or any other substance with a high percentage of carbon also finely powdered are mixed thoroughly and heated to dull redness without any contact with air. Asphalt of gas works is a capital reducing agent, as the hydrogen contained in it prevents the formation of polysulphides of barium. The argol residue from tartaric acid vats is also a good reducing agent. Another method used in some factories consists in mixing 100 parts baryte, 200 parts common salt, 15 parts charcoal powder, and roasting the materials in a reverberatory furnace, the salt being used to assist fusion. At the time of roasting the following reaction is supposed to take place:

$$BaSO_4 + 4C = BaS + 4CO.$$

When the reaction is complete, avoiding contact with air as much as possible, the barium sulphide is leached out after digesting the mass in vats and filtered. When the solution reaches a density of 17 degrees Beaume, long yellowish needle-like crystals separate out from the mother liquer, consisting of chemically pure barium sulphide. Any impurities in the baryte generally do not affect the purity of the barium sulphide formed. The metals, like copper, iron, and manganese that are occasionally present in the baryte, form insoluble sulphides, whereas barium sulphide is completely soluble. Barium sulphide has a hepatic odor and alkaline taste, and in water forms a mixture of barium hydrate and barium sulph-hydrate:

$$4BaS + 4H_2O = Ba(SH)_2 + Ba(OH)_2.$$

It should not be exposed long to the air, as it is then converted into Ba CO, and H_2S given off owing to absorption of moisture and CO_2.

With about 60 per cent concentration of the solutions and temperature of [illegible] deg. C., and when the zinc sulphate [illegible] vat will double the rate at which the BaS is poured we get a characteristic precipitate most easily filtered and dried. It is now placed in muffles and heated above 920 deg F., suddenly plunged into water, ground, washed thoroughly and dried and is ready for the market. Overheating should be avoided, as some of the ZnS then becomes converted into zinc oxide. Formerly 5 to 10 per cent of zinc oxide used to be present invariably in the commercial product, but as its presence decreases to a small extent the efficiency of the paint, the heating is so regulated that the percentage of zinc oxide present is very small.

Last year I carried on about twenty experiments in an attempt to make lithopone from baryte and the zinc carbonate mineral known as smithsonite and secured fairly good results. For reducing agent I used argol residue from tartaric acid vats containing about 95 per cent carbon. A slow prolonged heating to dull redness for about eight hours gave the best yield of BaS—about 56 per cent. Heating at a high temperature for three to four hours also gave fairly good, but somewhat low, results, varying from 40 to 48 per cent. The BaS was almost pure. For the manufacture of ZnSO4 from the carbonate, I got fairly satisfactory results from a method I devised. The ore was finely powdered and treated with crude H_2SO_4 and heated when a lumpy mass is formed and when hard it was powdered and roasted. There was about 2 per cent of iron in the ore which was oxidized and the zinc sulphate was then leached out by digesting with hot water. Another good method is to dissolve the mineral in H_2SO_4 and then treat the solution with bleaching powder and remove the precipitate by filtration, the iron being thus eliminated.

Lithopone has had quite a history in the market. When first brought out it was condemned as a hoax, as nobody would believe that BaSO4 could form a paint. But it has been able to outlive its condemnation by sheer merit. It is one of the most effective and durable of white paints. In the brilliant white of its color, its fine texture, and hiding power, it is scarcely surpassed by any one white paint, and change of weather or atmosphere has practically no effect on it. It finds use in many industries. It is indispensable and largely used in the manufacture of floor oil-cloth, as it does not oxidize in time, and also in the cheaper grades of enamel paints, as it does not combine with resin or semi resin varnishes. As a ready-made paint, it can be kept for an indefinite period in the package without deterioration. It is far better as a marine paint than zinc oxide and lead carbonate. Mr Toch, the well-known expert on paint, sums up its qualities in the following words: "As an interior white, a first-coat white, a ready-to-use flat paint for surface, or as a pigment in the lighter shades for floor paints, lithopone cannot be excelled for its body, durability, hardness, fineness of grain, and ease of application." Mr Toch also notices one peculiar habit, its photogenic property, i. e., its power to absorb light and give it out again. When it is mixed with linseed oil or varnish and then exposed to the direct rays of the sun, it turns grayish readily, and in shade regains its normal color. The reason of this is not known. But Prof. Ostwald has succeeded in eliminating this power of lithopone, and the discovery is covered with patents. Some chemists have tried to explain this by saying that the coloration was due to lead forming a lead sulphide. But this does not seem to be a satisfactory explanation, for in the manufacture of floor oil-cloth lead driers are always used and no coloration results, and moreover ZnS seldom liberates its sulphur in the presence of any neutral salt, and so strong is the chemical union that it is perfectly stable in the presence of organic acids.

It is rather interesting to know that BaSO4 is regarded in this country as an adulterant, thus lowering the value of a paint containing it, whereas in Europe its presence in paints, especially white lead, is valued for its whiteness, elasticity, on account of its insolubility in acids, its greater covering power, and



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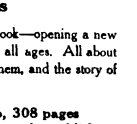
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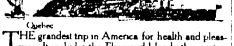
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Aviation Sickness

MODERN progress is not without its drawbacks, as would appear from the fact that after being familiar with mountain sickness, we are now to have the "aviator's sickness" inflicted upon us This expression does not mean any slight upon the numerous contingent of aeroplane flyers, but is an actual sickness which is felt by aeronauts, and Dr. Dastre spoke about it at one of the meetings of the French Academy of Sciences Several doctors were at work observing it recently and especially during the Bordeaux aeronautic week They noticed the effect upon the pilots of aeroplanes when flying very high, and also mounting or coming down very quickly When mounting in the air, they find that breathing becomes shorter when at 5,000 feet height, and this effect is more noticeable than with ordinary balloons The heart is noticed to beat faster, but generally there are no palpitations, and there is only a slight ill feeling which the aviator Morane thinks is a nervous sensation due to anxiety and the emptiness of space Buzzing in the ears is noticed only at a greater height, about 6,000 feet, although Legagneux felt a cracking noise in the ears when flying lower than this According to Morane, the view is always very clear, but another flyer had veritable hallucinations on one of his trips, and at each instant he imagined that he saw the tower of Notre Dame on his right, although he was hundreds of miles from Paris

When flying at 3,500 feet, and especially above 5,000 feet, the reflex movements of the system have a greater amplitude This appears to be due to a combination of causes, such as cold, a more rapid breathing, quicker heart beats the effect of sunlight and troubles of hearing, to which we must add nervous tension and fatigue The doctors also noticed what were the effects of a rapid descent in an aeroplane, and these appear to be a burning sensation in the face and redness One curious effect is a great tendency to sleep, and this is so strong that the eyes sometimes close in spite of all efforts to keep them open We must take it on the authority of Dr. Dastre that not long since a young pilot started out on an aeroplane flight, and was afterwards found fast asleep in the open fields When awakened, he did not remember how he had come down. Thus the different kinds of "aviator's sickness" are likely to give some startling results

High Tension Discharge Apparatus

AT the recent soiree of the Royal Society, Prof E Wilson and Mr W. H. Wilson exhibited an improved high tension discharge apparatus. Energy is stored in a magnetic field by inductance, from a low frequency circuit, and in so stored the condenser is mechanically bridged across the primary winding of an induction coil, thus forming a high frequency oscillating circuit The energy is then transferred by the secondary winding to the work circuit. The above cycle of events is controlled by a motor-driven interrupter. Tapping points on the inductance winding allow of a suitable range of voltages being used.

Aeronautics

Detroit Aviation Meet.—About $15,000 has been raised for prizes for the Detroit meet, which is to be held for 6 days from June 30th to July 4th inclusive.

Aeroplanes in Department Stores.—As he was the first to exhibit a Blériot monoplane in his stores in New York and Philadelphia, so John Wanamaker is also the first to put an aeroplane on sale in his New York store. He is exhibiting there a Moisant monoplane of the Blériot type, which is shown equipped with an Anzani motor for the sum of $4,000 There is also on exhibition an imported French balloon, the price of which is but $1,500. It is probable that other department stores will adopt this idea, which will enable ardent aviators to purchase machines at a moment's notice, if not to fly them as quickly.

The International Speed Race.—For the third time the French will try to capture the Bennett trophy in England on July 1st. France has a better team this year than ever before. Alfred Leblanc will again pilot a 100 horse-power Blériot and will have as team mates M. Edouard Nieuport and M. Chevalier on Nieuport monoplanes, which machine holds the record for nearly the distance of the race—145 kilometers—at 80 miles an hour Auburn will be the substitute if any is needed To defend the cup England will have Gustave Hamel with a 100 horse-power Blériot, Alex. Ogilvie with a powerful "baby" Wright, and one other aviator yet to be chosen. America will have only Charles T Weymann, who, nevertheless, stands a good chance with a fast Nieuport monoplane Austria will send Herr Flesch, with a fast monoplane, and Germany will also be represented The race will be run at Eastchurch, Isle of Sheppey, and will start at 11·46½ A. M.

Hamilton Flies Around the Connecticut State Capitol.—Emulating Tom Sopwith's flight around the Philadelphia city hall recently, Chas K Hamilton flew about 10 miles from New Britain, Conn. (his home town), to Hartford, where he circled several times the 274 foot-high dome of the capitol before flying over the heart of the city and continuing for 15 miles farther up the Connecticut River toward Springfield. Hamilton turned without alighting and flew back home. His flight was a demonstration of the freedom of the aviator. After Jan. 1st, 1912, all aviators, balloonists and dirigible pilots must obtain a license in order to fly in the Nutmeg State, and no one under 21 years of age can enjoy any of these sports. This is in accordance with the provisions of the bill drafted by A. Holland Forbes and recently rushed through the Connecticut legislature. Having fallen through the roof of a house once himself the famous balloonist wants to protect his fellow citizens, as far as possible, from the chance of any such accident.

The Waltham, Mass., Meet.—The second aviation meet to be held near Boston occurred at Waltham from June 15th to the 20th. Jas. V Martin, who has lately returned from England with his wife, who is also a flier, made some excellent exhibition flights with a Blériot monoplane and a Burgess biplane. Ovington made several sensational flights over Waltham, Boston, and the surrounding towns In his longest flight across Boston he was gone half an hour. He flew across the city and out over the harbor and back Harry Atwood with his Burgess-Wright biplane made a number of cross-country trips with passengers, the chief of which was his trip to Concord, N. H, with a passenger. He flew in a very strong wind and stopped to change passengers at Lowell, Nashua, and Manchester. He covered 75 miles in about two hours flying time The following day he flew still farther with another passenger Atwood's flights in a Wright machine in a strong wind are in line with the performance of Ogilvie in an S.E.C.-engined Wright in England recently, when the wind was so strong that the aeroplane hovered above a given spot but could make no forward progress.

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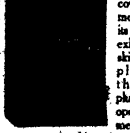
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Electricity

Telephone Train Dispatching on the Lehigh Valley.—A large part of the Lehigh Valley Railroad now uses the telephone for train dispatching. It was decided recently to extend this system to practically the entire road. An order has been placed for the apparatus, and with the exception of a short stretch of ninety miles on the West Buffalo Division, the entire Lehigh Railroad will soon be using the telephone train dispatching apparatus.

Electric Lights in the Society Islands.—According to a recent consular report, an American living at Papeete, in the Society Islands, has installed an electric lighting system in the city. He has placed at the street crossings 100 candle-power lamps, with 40 candle-power lamps at other points. The lights are very astonishing to the natives, who travel miles to see them. The plant consists of two 30-kilowatt generators, one 10-kilowatt generator, and one 5-kilowatt generator, with a total capacity of 3,000 20 candle-power lamps.

Mining Gold with Electric Dredges.—More than twenty-five per cent of the gold mined in California is now recovered by means of dredges. Formerly the dredges were operated by steam power, but this was expensive owing to the scarcity of fuel. Now that California is utilizing its streams for the generation of electricity, electric power is available throughout the State at low costs. Gold dredges are accordingly being equipped with electric motors, which have not only proved more economical but have shown themselves to be more adaptable for this class of work because of their ability to run continuously without much attention and with almost perfect reliability.

Pilot Cells for Electric Vehicle Batteries.—It is not always possible to judge accurately of the condition of a battery with a voltmeter, particularly if the battery is not new. Heretofore, however, this has been practically the only method that could be used, for the reason that the cells are sealed and it is a difficult matter to reach the electrolyte for the hydrometer tests. As however the hydrometer test is the only reliable one, a storage battery manufacturer has recently brought out a pilot cell in which a hydrometer is permanently incased behind a small glass-covered opening. Readings may be taken at any time and a card attached at one side of the battery shows the mileage available for different gravities.

Protecting Pipes Against Electrolysis.—It is well known that underground pipes are injured, not when stray currents enter them, but when they leave them. Such being the case, the city of Karlsruhe, in Germany, has used a system which will prevent a stray current from leaving the pipe. A set of plates and pipes are buried close to the water pipe at the points where electrolysis is liable to occur, and these are connected to the positive pole of a storage battery or generator, while the water pipe is connected to the negative pole. As the voltage of the stray currents that produce electrolysis is usually quite low, the expenditure of power required to maintain the requisite current in the water pipe is not costly. So far this system has proved very efficient.

Measuring Candle Power with a Thermopile.—In a paper read before the London Royal Society, of recent date, A. R. Houstoun referred to a system for measuring candle power by means of the thermopile. Ordinarily this is impossible owing to the fact that the thermopile is affected by invisible as well as the visible waves. However, it was found that by using a light filter consisting of solutions of copper sulphate and potassium bichromate the ultra-violet and infra-red rays are entirely stopped so that only the visible portion of the spectrum passes through and impinges upon the thermopile. The author suggests that this means be used for measuring the intensity of light, employing as a unit that intensity which would produce 0.8 erg per square meter per second at a distance of one meter.

Science

Michelsen Honored at Goettingen.—The University of Goettingen on June 15th conferred the honorary degree of doctor of philosophy upon Prof. Albert A. Michelsen, of the University of Chicago, and exchange professor at Goettingen.

Wolf's Periodic Comet.—A cablegram has been received at Harvard College Observatory from Kiel stating that Wolf's Periodic Comet was observed by Prof. Max Wolf at Heidelberg, 1911, June 19 4752 in R A 18 h 46 m 16s, Dec +12° 28'. The comet is visible in a large telescope.

Anti-Typhoid Vaccination in the Army.—On the recommendation of Major General Leonard Wood, Chief of Staff, the Secretary of War has ordered that anti-typhoid vaccination, which for more than a year has been voluntary in the army, shall be administered to all recruits except those over 25 years of age.

An Expedition to Jan Mayen.—The American Geographical Society has received notice that Mr. J. Foster Stackhouse, of England, has organized an expedition to visit, during the present summer, the island of Jan Mayen, which lies far to the northeast of Iceland, in the direction of Spitzbergen. With the expedition will go, as geologist, Mr. W. S. C. Russell, of the Central High School, Springfield, Mass. Jan Mayen was one of the points occupied by the international polar expeditions of 1882-1883, viz., by the Austrian expedition under Wohlgemuth.

Wireless Communication with Spitzbergen.—Roughly speaking, Spitzbergen lies a thousand miles north of the Arctic Circle, but, in contrast to other regions of equally high latitude, it has become the field of active exploitation. Its coal mines are being worked most profitably, and it is now visited every summer not only by the fishing-fleets, but by large parties of tourists. The great need of telegraphic communication is about to be met by the Norwegian government, which has decided to establish a wireless station at Green Harbor. The nearest point of wireless communication will be Hammerfest, 750 miles distant.

Meteorological Stations in the South Pacific.—The director of the Chilean meteorological service, Dr. Walter Knoche, recently began a cruise on the naval schoolship "General Baquedano" in the course of which he was to establish a first order meteorological station on Easter Island, the most easterly Island of Polynesia. It is intended to keep this station in operation for at least two or three years. Seismological observations will shortly be undertaken at the same point, under the direction of the Chilean Seismological Institute. On his return voyage Dr. Knoche expected to stop at the island of Juan Fernandez, where, if possible, another meteorological and seismological station was to be established. As this island is to have wireless telegraphic communication with the mainland, it is probable that Juan Fernandez (the locale of "Robinson Crusoe") will become an important outpost of the weather forecasting service of Chile.

Amundsen's Antarctic Expedition.—As already reported in this journal, Capt. Amundsen, who left Norway ostensibly for the Arctic regions, where he proposed to make a five years' drift across the Polar Sea, recently turned up, to the surprise of the scientific world, in the Antarctic, where he was found by the English ship "Terra Nova" preparing for an attack on the south pole. His change of plans has now been explained by Dr. Nansen, in a letter to the London *Times*. It appears that he wrote to Nansen from Madeira that, owing to the diminished popular interest in the north pole since the successful result of Peary's last expedition, he felt convinced that he should not be able to raise sufficient money for the proposed long voyage in the Arctic. He therefore decided upon the more popular and less expensive plan of vying with Scott, Filchner and the others in a dash for the south pole. A press dispatch, dated June 17th, states that Pedro Christophersen, a Norwegian in business in Argentina, has agreed to finance Amundsen's expedition to the extent of $50,000.

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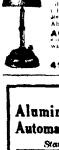
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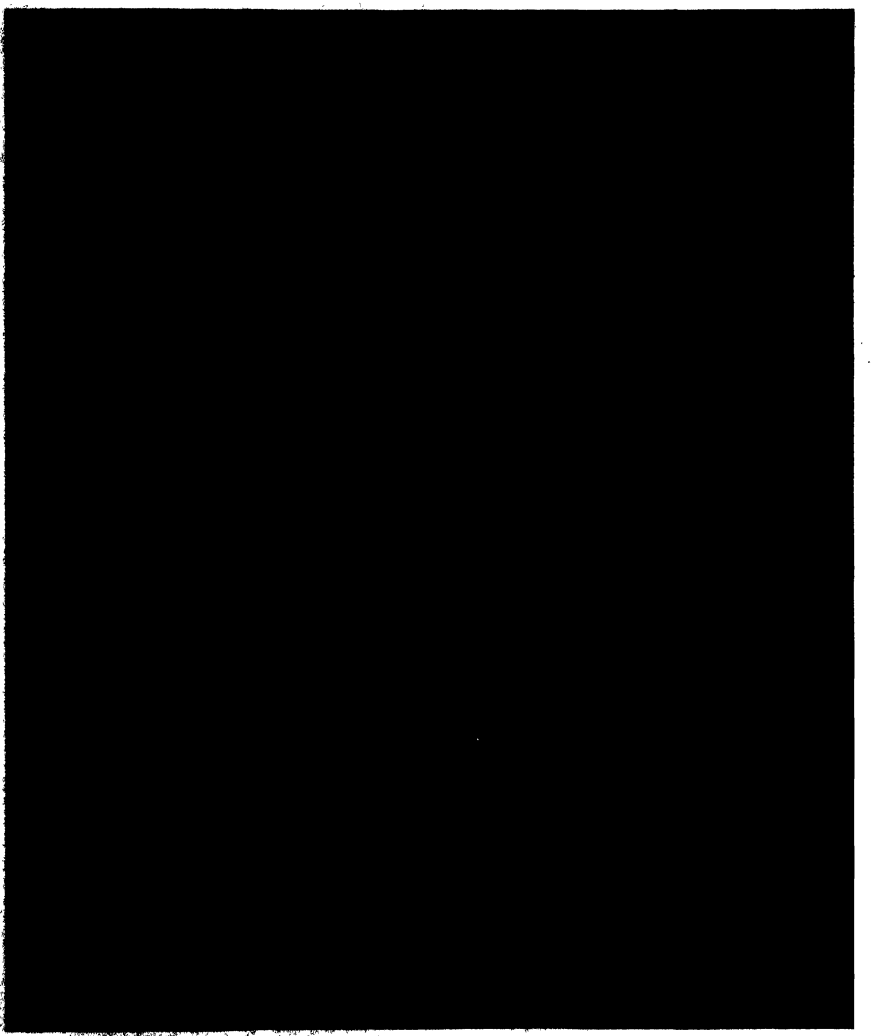


Fig. 1.—The city of Leipsic as it appeared to the passengers of the "Parseval III."—[See page 24.]

FINDING YOUR WAY IN THE AIR

SCIENTIFIC AMERICAN

Founded 1845

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The purpose of this journal is to record accurately and in simple terms, the world's progress in scientific knowledge and industrial achievement. It seeks to present this information in a form so readable and readily understood, as to set forth and emphasize the inherent charm and fascination of science

The Subway Muddle

A FEW years since the SCIENTIFIC AMERICAN had much to say about the development of New York's system of subways. For the past year or two, as our readers know, we have been silent on the question, and this for the reason that we have found it practically impossible to suggest any best way out of the maze of opposing schemes which have been presented and discussed. When the idea of building the Tri-borough Subway took definite form, we had hoped that out of the melting pot into which the propositions and counter-propositions of the Public Service Commission and the Interborough and Brooklyn Rapid Transit Companies had been cast by the city officials, there would have come a comprehensive and acceptable scheme which would serve the best interests, both of the public and the operating company. But we have to confess that the practical results, if they may be called such, seem to us at the present writing to be decidedly disappointing.

After a careful consideration of the discussions of the past few months, we find ourselves more and more inclined to agree with our practical and far-sighted Mayor, in his conviction that the best policy of the city would be to permit the Interborough, the present operating company, to build all the needed extensions in Manhattan, the Bronx, Brooklyn, and Long Island, and operate them for a single five-cent fare. But we would attach to this proposition a most important clause—namely, that the hands of the Public Service Commission should be strengthened to give them such an immediate control of the operating features of the road that the comfort, convenience, and proper self-respect of the traveling public, will be absolutely safeguarded.

But let it be understood, just here, that we hold no brief for the Interborough Company. On the contrary, we believe that their extreme unpopularity, of which they must surely be very well aware, is fully deserved, being due to the obstructionist attitude which they have shown to the requests of the New York public as expressed through its representatives, the Public Service Commission, notably in the matter of providing accommodations in those intervals between the rush hours, in which, if the Interborough had shown a friendly and reasonable attitude, it could easily have provided a seat for practically every passenger. There was a period of several months during which the attitude of the Interborough to its patrons, as expressed in their obstructionist policy to the Public Service Commission, was one of supercilious contempt and total disregard either for their convenience or comfort.

On the other hand, we wish it to be clearly understood that on the purely physical, the engineering side, we consider the work of the Interborough in perfecting its system to have been simply magnificent. In no other city can there be found twenty-five miles of road which, in the combined speed and number of its trains, in the perfection of its signaling system, in the multiplication of safeguards against disaster, and in the enormous multitudes that are carried day in and day out, with practically no accidents whatever, can compare with the New York subway as operated by the Interborough Company.

In the effort to get the largest number of trains over their tracks in the shortest possible time, the company appear to have made cost the last consideration.

In view of the above facts, it is simply amazing that they should have shown such a "picayune" spirit, in hastening to cut off cars the moment the rush hour was over, and at the very time when the wonderfully patient New Yorker would naturally look for a seat.

Now the Interborough Company is extremely anxious to build the whole subway system as originally laid out by the Rapid Transit Commission, with such further enlargements as the growth of the city and the demands of Brooklyn and Staten Island have made imperative. With paste pot and placard they have spread their appeal on car and platform, and elevated pillar. There is no question whatever about the anxiety of the Interborough to keep out every competitor and build a "five-borough route operated for a five-cent fare."

But this slogan of the Interborough is nothing more nor less than the dream of the average workaday citizen of New York. He wants it badly, but he also wants it comfortably, decently, and rid of those brutalities which disgrace the Interborough's present methods of handling their passengers. The ten-car train in rush hours has done much to mitigate the horrors of subway travel; the eight-car train between rush hours would have a similar effect. The average citizen cares very little who builds, owns, or operates a "five-borough, five-cent" system; but he cares very much indeed whether the system is to be operated along the lines of disgusting indecency which mark the present methods, and he demands that whatever new system may be built, it shall be no longer necessary, when he gives up his five-cent fare, to also forego his self-respect, his elementary sense of decency and his native inborn chivalry toward women.

Now the SCIENTIFIC AMERICAN pointed out some months ago that the reasonable comfort of the passenger could be secured if the representatives of the traveling public, namely, the Public Service Commission, were empowered to see that their mandates were carried out to the letter by the operating company. To do this, it would be necessary merely to insert a clause in the contract with the operators of the subway, to the effect that whenever an employee, big or little, of the operating company, became obnoxious through failure to follow the orders of the Public Service Commission, the Commission would have power to summarily dismiss him, be he train-guard, center rush at car doors, or general manager.

Such a clause is to be found to-day in the printed forms of contracts for big city works—bridges, public buildings, etc. The same policy is followed in all great railroad contracts throughout the country. It works like a charm. What the chief engineer says, goes, and it is extremely rare for him to have to exert the drastic authority with which he is invested.

So the SCIENTIFIC AMERICAN would suggest that the Interborough Company be permitted to carry out the programme of construction which it has so prayerfully submitted to its long-time pushed and elbowed and buffeted patrons, with the understanding, however, that they, the patrons, are to be placed in a position where they can demand and enforce every possible consideration as to accommodation and courteous treatment that the exigencies of the situation will allow.

Necessity and Invention

ANYONE who scans a copy of the *Patent Office Gazette* with the notion that necessity is the mother of the entire brood of inventions therein contained, is destined to receive a rude shock. What an enormous family! Nine hundred and ninety-seven thousand to date, and increasing at the rate of six hundred new little necessities each week! But what an odd and varied brood, and are they all really necessities? Here is a strange one that was actually patented—a scheme for controlling horses by electricity. If the animal balks, a powerful and well-placed shock will make him spring forward in spite of himself. If he tries to kick, his muscles will be cramped by a paralyzing charge of electricity. Instead of bridle and reins, the all-powerful current may be used to give him a shock on the left cheek in order to turn into the right fork of the road, or on the right to make him take a left turn. Instead of sawing away at the lines, the driver may sit back in comfort, and, by means of push-buttons, typewrite the beast into submission.

Needless to say, this weird invention is an intruder in Mother Necessity's family. Alas! there are many such intruders. But a large number of inventions equally unnecessary are not so palpably foolish. The worst offender is the man who is not content with developing and improving the arts in which he is regularly employed, but feels that he must do missionary work in strange and unfamiliar territory. A farmer who has never been beyond the boundary of his own county will invent fire escapes for skyscrapers. A city clerk whose knowledge of the country has been gained from a trip to Bronx Park will invent an automobile plow. Sailors on the high seas will tackle the baffling problem of making safe rail joints, while the man from the Middle West almost invariably turns his attention to ship propellers and wave motors. An idea comes to such a man and he hastens to the Patent Office with it. It may be that he will give it a superficial examination; but the chances are that he will think it unnecessary to make his examination thorough, or else he will be afraid of divulging his secret by too searching an investigation.

Not long ago a man was struck with the brilliant conception of having rotary heels on shoes, the idea being that the wear would be evenly distributed and that the heels would not be run down on one side. The invention seemed so original to him that he thought it unnecessary to investigate the state of the art; however, he was persuaded to have a search of the Patent Office made, and much to his astonishment he found an entire sub-class devoted to this one particular branch of shoe-making, in which scores of patents had been secured on every phase of the idea. Of course this inventor's design was slightly different from the rest, and he might have secured a patent with a limited claim or two; but he was wise enough to see that his scheme was not necessary, and was therefore useless.

Until he has discovered the fact by rude personal experience, it is usually hopeless to tell a man with an idea that his invention is unnecessary. A man who is dabbling in arts of which he knows little or nothing will not listen to advice. You cannot tell him that invention, like charity, begins at home, because it does not, always. There have been exceptions, and notable ones, too, in which a man who is unfamiliar with a process or machine for doing a certain kind of work has attacked the problem from an entirely original point of view, and has developed an improvement of great value. It is these exceptions that encourage the precipitate man to begin invention in foreign fields.

We do not wish to create the impression that it is only the necessary invention that is worth while. Many of them appear unnecessary, and actually are unnecessary until the necessity for them has been naturally or artificially created. Many years ago a thin, emaciated young man in Boston who was literally starving, spent all his time with a series of experiments that seemed absolutely worthless. He carried his investigation so far as to employ a mummied human ear, and many an evening he spent whispering in this ghastly ear, trying to record the vibrations of the ear drum. The outcome of these experiments is the telephone of to-day. It was an unnecessary invention when first patented, a scientific toy, and no one seemed to see any particular value in it; but the need for it was built up after the invention was made. Verily, the successful inventor must be prophetic, in seeing a real necessity for his device, and the preliminary to success lies in careful, painstaking study and a thorough knowledge of every phase of the art.

The Bad Spelling of the Great

THE numerous members of the rank and file of humanity who have trouble in remembering the number of *n's* and *t's* in "Britannica" will derive much consolation from examining a pamphlet recently circulated by the publishers of the new edition of the world's greatest encyclopædia. This pamphlet contains facsimile reproductions of letters received from eminent people—college presidents and professors, judges, senators, and others—expressing their appreciation of the new work. Of seventy letters, some typed and the rest in autograph, no less than seven—ten per cent—misspell the word "Britannica."

So far as the purely scientific vocabulary is concerned, probably the word more often misspelled than any other is "sidereal." We notice that *Science reports the fact* that Prof. Svante Arrhenius recently lectured before the Washington Academy of Science on "The Siderial Cultus," and this announcement has been copied, in its original orthography, in the *Bulletin of the American Geographical Society*. As it happens this little slip on the part of two usually impeccable publications was entirely gratuitous, for the reason that the distinguished Swedish savant changed his programme at the last moment, and delivered a lecture on "The Atmosphere of the Planets."

George Ellery Hale

America's Foremost Solar Physicist

By Frederick Slocum of the Yerkes Observatory Staff

IN the report of the president of the Carnegie Institution of Washington for 1905 appears a list of the departments of scientific investigation to which the larger grants were assigned and the amounts of those grants. The sum of the sixteen grants mentioned is $304,500. One item in the list is "Solar Observatory, $150,000." According to the report for the next year a second grant of an equal amount was made to the Solar Observatory, and in each of the subsequent years large amounts have been assigned to the same institution. This fact has a two-fold significance; first, it shows the importance of solar research and the allied investigations which tend to interpret the universe, and secondly, it signifies the great faith of the trustees of the Carnegie Institution in the one man who was selected to build and direct its great Solar Observatory. This man was Prof George Ellery Hale of Chicago. Prof. Hale was born in Chicago in 1868. He received his collegiate education at the Massachusetts Institute of Technology, from which he obtained the degree of B.S. in 1890. While in college he had been especially interested in physics, and particularly that part of physics which involves spectroscopy. In 1892 he established a private physical laboratory in Chicago, which was known as the Kenwood Physical Observatory. In all of his mechanical and scientific tests a thorough course in manual training stood him in good stead, and he was especially fortunate in having the constant encouragement of his father, a successful inventor, manufacturer and business man. In 1891 the observatory was equipped with a 12-inch Brashear telescope and a powerful spectroscope. Prof. Hale's program, as announced at the dedication of his private observatory in 1891, called for "a thorough study of solar phenomena and particularly spectroscopic investigations of the spots, chromosphere, and prominences." For twenty years this program has formed the basis of all of his researches, and the success which he has achieved has completely revolutionized the methods of solar investigation as well as the interpretation of solar phenomena.

While still a student at the Massachusetts Institute of Technology Hale became interested in the study of the sun, and published several articles on that subject in the Massachusetts Institute of Technology *Quarterly* and in the *Astronomische Nachrichten*.

The particular phase of solar research that interested him at that time was the study of prominences. For years these objects had been observed only during total eclipses of the sun. After the eclipse of 1868 Janssen and Lockyer had independently discovered a method of using the spectroscope so as to render the prominences visible in full sunlight. Prof. Hale attacked the problem of photographing the prominences. His first experiments were performed at the Harvard College Observatory in 1889 and 1890, but met with poor success. His failure, however, was due to inadequate apparatus for his special problem rather than to any fault in his method, and this led to the construction and equipment of the Kenwood Astrophysical Observatory in 1891.

Within a year from the time this observatory was dedicated the problem was solved by the invention of an instrument called by Prof. Hale a *spectrohelioscope*. Without going into the technical details of this instrument, it may be described as a spectroscope so modified that any single line of a spectrum may be isolated and a photograph taken in the light of the element which produces the line. The spectrum of a solar prominence consists chiefly of the lines of hydrogen, helium and calcium. Using the *K* line of the latter element, Prof. Hale succeeded in making beautiful prominence photographs. A single exposure of two or three minutes' duration gave a record of all the prominences around the edge of the sun. By taking successive photographs at any convenient interval the changes in shape and general behavior of these most interesting solar features could be studied at will.

As soon as the spectrohelioscope was put into practical use it was found that the photography of the prominences was only one of many lines of solar research to which it was adapted. It rendered possible the photography of the sun in the light of any one of the elements which are conspicuous on its surface. These photographs show not only the distribution of such elements as hydrogen and calcium over the sun's surface, and the changes in this distribution from day to day, but also show how the clouds of the different gases vary in size, shape and distribution at different heights above the surface of the sun.

The spectrohelioscope opened up a new and wide field of solar research. Before it had been in use a year many new phenomena were discovered and many new theories of old phenomena were suggested. These brought honors in abundance to Prof. Hale. In 1895 the French Academy of Sciences awarded him the Janssen medal "for the construction and use of the first successful spectrohelioscope." This was followed, in 1902, by the Rumford medal of the American Academy of Science, in 1903 by the Draper medal



PROF. GEORGE ELLERY HALE

Director of the Mount Wilson Solar Observatory.

of the National Academy of Sciences, and in 1904 by the gold medal of the Royal Astronomical Society. Honorary membership in many foreign societies was conferred upon him. Colleges and universities have also paid tribute to his genius, and he has received honorary degrees from various institutions, including Yale, Manchester, Oxford and Cambridge.

Just as Prof. Hale's experiments at the Harvard Observatory led to the establishment of the Kenwood Observatory with its more specialised equipment, so his success in the researches carried on in the latter institution led to a desire for a larger observatory with more powerful instruments. The matter was brought to the attention of President Harper of the University of Chicago, who took an active interest in the realization of the plan. Mr Charles T Yerkes agreed to finance the undertaking, and the outcome was the great Yerkes Observatory of the University of Chicago, located at Williams Bay, Wisconsin, 76 miles northwest of Chicago. Ground was broken in 1893, and the observatory was dedicated in October, 1897. Prof. Hale was appointed director of the observatory and professor of astrophysics in the University of Chicago. A complete description of the Yerkes Observatory would be out of place here. It will be sufficient to note that the chief instrument is a refracting telescope with a lens 40 inches in diameter and a focal length of 63 5 feet, the largest telescope of its kind in the world. There are various other telescopes designed for special purposes and a complete equipment of accessories. The observatory and its equipment cost approximately $365,000.

The chief aim of the Yerkes Observatory was a continuation on a much more elaborate scale of the work so successfully begun at the Kenwood Observatory, but the program as announced by Prof. Hale included, in addition to the various classes of solar work, micrometrical observations of double stars, planets, satellites, nebulæ, comets, etc., stellar parallax work, photographic studies of stellar spectra, including determinations of motion in the line of sight; photometric observations, and various physical researches in the laboratories. In order to carry out all of these researches a large staff was required, and Prof. Hale was fortunate in securing such men as Burnham, Barnard, Frost, Wadsworth, Ritchey, Ellerman, Adams, Barrett, Parkhurst and Fox.

For ten years Prof. Hale served as director of the Yerkes Observatory, and during that time the institution assumed a position among the foremost observatories of the world. In 1903 a combination of circumstances including the completion of the five-foot mirror for a reflecting telescope, the gift of Prof. Hale's father; the desire to experiment under the very best conditions with new types of apparatus for solar observations, and the rigorous winters of Williams Bay, led to the decision to establish a branch observatory where the climatic conditions were most favorable. The summit of Mount Wilson near Pasadena, California, was finally selected as the site of the new station. For some months observations were made with instruments borrowed from the Yerkes Observatory, then the Carnegie Institution, devoted exclusively to the furtherance of research, agreed to finance the undertaking, and with the cordial co-operation of the University of Chicago the new observatory severed its connection with the Yerkes Observatory, and in 1904 Prof. Hale became director of the Mount Wilson Solar Observatory of the Carnegie Institution of Washington. For the third time Prof. Hale had the privilege of planning and equipping an observatory.

In many respects the Mount Wilson Observatory is unique. It has no great building like the Yerkes Observatory, nor does it possess any large refracting telescope. Its instrumental equipment includes the Snow reflecting telescope with a mirror of 24 inches aperture and 60 feet focal length, mounted horizontally; a refracting telescope of 12 inches aperture and 60 feet focal length mounted vertically, a refracting telescope of 12 inches aperture and 150 feet focal length, mounted vertically, a reflecting telescope of 60 inches aperture and 75 feet focal length, mounted equatorially, and in course of construction, a reflecting telescope of 100 inches aperture. The first three instruments are fixed in position, the light of the sun being reflected into them by a combination of mirrors. These three are designed exclusively for solar investigations and are fully equipped with such accessories as spectrographs and spectrohelioscopes. These instruments are all mounted on the summit of Mount Wilson. In the city of Pasadena the observatory has a physical laboratory, a building with offices and computing rooms, and another containing machine, instrument, and optical shops.

Here again a large staff is necessary. In addition to Prof. Hale this includes at present Messrs. Adams, Ellerman and Ritchey, formerly of the Yerkes Observatory staff and also Messrs. St. John, Seares, Fath, King, Pease, Babcock and several assistants, computers and machinists.

Of the many achievements and discoveries of Prof. Hale and his colleagues at the Mount Wilson Observatory, a few only will be mentioned, viz.: Investigation with the spectrohelioscope of hydrogen and calcium flocculi on the sun, including structure at different levels and relationship to spots, determination of the law of solar rotation (a) by the motions of the hydrogen and calcium flocculi, (b) by the

(Continued on page 37.)

How to Find Your Way in the Air

Aeronautical Signals; Aeronautic Charts; Steering by Compass

THE rapid progress of aviation and aeronautics obviously demands the development of a system of signals which will enable pilots to find their way in the air and will also indicate convenient landing places, atmospheric conditions, etc Some of the most important events of the year are long cross-country flights Racing in a small closed circuit will gradualy be abandoned The establishment of regular lines of airship transit, as proposed by Count Zeppelin, and the success of aerial touring in general, also depend on the invention of such a system of signals

One proposed method involves the construction of special aeronautical charts, another requires merely the establishment of easily visible signals by which the pilot can find his position on the very accurate ordnance maps which are commonly used as standard maps in France and other European countries In the French system the country is divided into 258 districts, each of which extends about 38 miles east and west and 24 miles north and south, and is represented by a numbered section of the map

According to one proposed system of signals, a large rectangle having the proportions of the corresponding map section and in the correct relative position to the points of the compass, will be marked out on the roof of a balloon shed or other building, or on the ground (Fig 10) The rectangle is marked with the number of the section, and the exact position of the locality in the section is indicated by a conspicuous mark For example, the towns of Beauvais, in section 32, and Nantes in section 117, would be indicated as is shown in Fig 10b A glance at any one of these signals near which he passes will show the pilot his exact place on the map, so that he need not be long lost or go far astray if the signals are sufficiently numerous A predetermined course can be followed without carrying a set of maps It is necessary only to draw, on a small card, a rough outline of the sections crossed by the course and adjacent thereto, to mark each section with its proper number, to mark the positions of the starting and destination points, and to connect these points by a straight line A diagram for a flight from Orleans to Mourmelon is shown in Fig 10b It will be observed that the straight course crosses the northwestern part of section 81. Hence, if the aviator comes to the signal shown in the lowermost portion of Fig. 10b, which indicates a point in the southwestern part of section 81, he knows that he has deviated toward the right hand. The map is required only for the purpose of selecting a good landing place, if the goal is a large town

If the signals are composed of white lines on a black background, or conversely, they need not be very large in order to be visible at a considerable distance A rectangle 12 feet broad and 20 feet long, with lines 20 inches wide and figures 6 feet in height (in actual use at Mourmelon) is easily seen from a distance of one mile and an elevation of 600 feet.

In another system, indorsed by the French National Aerial League, each signal will consist of two numbers, indicating the distance in kilometers north or south, and east or west, of Paris. These signals can also be used in combination with the ordnance maps.

The lines, figures and backgrounds may be painted, or composed of colored tiles, etc Figures composed of silvered glass balls have been employed in experiments at the Eiffel Tower (Figs. 3 and 4).

A person possessing good sight can distinguish parallel lines, properly illuminated, when each line and space has an angular breadth of 1 minute, and can recognize Roman capital letters which subtend an angle of 5 minutes. Hence the letters and figures of signals for the use of aviators flying 1,000 feet above ground should be at least 16 or 18 inches high, and should be composed of lines at least 3⅕ inches broad. These, however, are lower limits, which hold only for motionless, attentive and keen-sighted observers. The aviator's acuteness of vision, like that of most persons, may be somewhat impaired, and if he is alone his attention is distracted by the control of his machine, while even a separate observer finds it difficult to recognise objects which he passes at a speed of 50 miles per hour, or 75 feet per second. Hence the letters and figures should be from 3 to 5 feet high, and their lines from 7 to 12 inches broad. The "antique" capital letters and Arabic numerals adopted for oculists' use by the international ophthalmological congress of Naples in 1909, are the best for aeronautical signals. The more easily recognizable letters, such as A, E, V, should be preferred to the less easily recognizable, such as S, Z, B, R, and the employment of similar letters (M and N, or B and R), as well as the arrangement of letters and figures in one line should be avoided. Although vision is more acute in the open air at noon in clear weather than in an oculist's examining room, it must be remembered that only one day in three is perfectly clear, that aviators prefer the relatively calm morning and evening hours, when mists are frequent and sunlight is less intense, and that the air above large cities is usually laden with dust and smoke. These con-

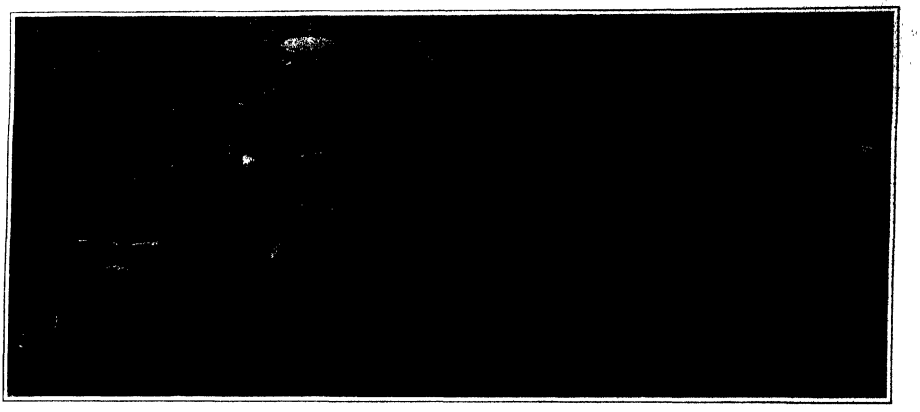


Fig. 2.—A voyage over the Alps in the balloon "Augusta." View of Vill and Igls in the neighborhood of Innsbruck.

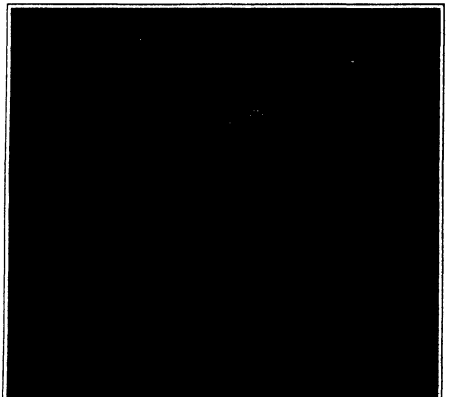


Fig. 3.—An air beacon.

CHARTING THE INVISIBLE OCEAN OF AIR

dictate that the choice of colors used in signals to black and white, or very dark and very light tints. As four or five men in a hundred are more or less colorblind, colored signals, which have caused many accidents on railways and in navigation, should be rejected.

In Germany, it has been suggested to divide the country into districts, and to designate each district by a number and a letter, which would be suitably inscribed on roofs or on signs suspended from captive balloons.

For the guidance of aviators and aeronauts at night a German inventor has devised a translucent red balloon about 8 feet in diameter, containing an electric light of 100 candles or more, and moored by means of an electric cable (Fig. 5). These balloons are easily distinguished from other lights, and from stars, and can be seen from a great distance. Some are already used near Berlin for guiding the nocturnal flights of an advertising airship. They may be employed as captive balloons for marking the positions of airship stations, sheds and landing places, and to indicate the proximity of the sea or other source of danger. They may also be equipped with accumulators and employed as pilot balloons, to indicate the direction and velocity of the wind before starting on a nocturnal flight. In foggy weather, the signal balloon may carry an automatic electric fog-signaling device by which a bell on the ground is rung when the balloon emerges from the bank of fog. These devices are patented and controlled by the Aix-la-Chapelle company.

A signal of a type which is already used to some extent in Belgium is shown in Fig. 6. It consists of a white cross of stone or wood, placed horizontally on the ground and inscribed in large black letters with the name of the place. The pointed top of the cross is directed northward, and supplementary arms indicate by their positions and inscriptions the distances and directions of landing places, shelters, forests, bodies of water, etc.

While aviators and aeronauts have been discussing the merits and demerits of various systems of marking places with signals that he who flies may read, the French War Department has commenced the construction of a map designed especially for use in aerial navigation. The need of such a map was felt keenly during the maneuvers in Picardy, where the pilots of the military airships were compelled to rely on the compass and the regular ordnance maps. The compass is of little utility except in long flights, and even then the lateral drift of the vessel makes it almost impossible for the pilot to keep his bearings, particularly if the view of the land is interrupted by fog. The ordnance maps are very accurate, but they are overloaded with details which only confuse the aerial pilot, who requires only a few conspicuous points of reference, which can be seen and recognized from a considerable distance. These points, as a rule, possess little military importance, and are, therefore, not very conspicuous in the ordnance maps.

The need of special aeronautic maps having been demonstrated by the first official experiments in military aviation, Commandant Pollachi, of the Geographical Service of the Army, last September, undertook the task of preparing such maps, with the aid of expert assistants, excellent equipment, and full and accurate information at the command of the French Geographical Service.

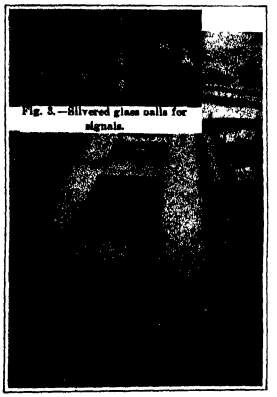


Fig. 3.—Silvered glass balls for signals.

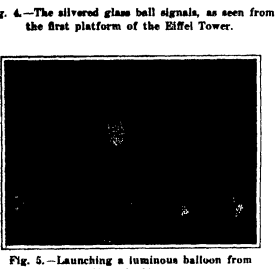


Fig. 4.—The silvered glass ball signals, as seen from the first platform of the Eiffel Tower.

Fig. 5.—Launching a luminous balloon from Aix-la-Chapelle Observatory.

The German general staff had already issued some special aeronautical maps, but, in Commandant Pollachi's opinion, the German maps are overloaded with detail and are drawn on too small a scale (1 to 300,000), and had consequently proved unsatisfactory in the German maneuvers of last year. Profiting by these mistakes, Commandant Pollachi adopted a scale of 1 to 200,000, which permits the introduction of all data useful to aerial navigators, and yet allows a territory measuring 50 by 80 miles to be included in a map measuring 16 by 26 inches.

The first map is already completed, and a portion of it is reproduced in Fig. 7. It is free from all useless and confusing detail, and represents the actual appearance of the country as seen by aviators, as closely as possible, so that it resembles a sort of conventionalized photograph rather than an ordinary topographic map. For example, the highways, which appear to the aviator as long white ribbons, are represented by unprinted strips of fine white paper on the map, bordered by black lines. The general ochre tint of the map resembles that of the ground. Cities, towns and villages are not indicated by the conventional little circles, but are represented by red hatchings of the exact shapes and relative sizes of the real communities. Cathedrals and large churches are indicated by black silhouettes of their main façades, so that they can be recognized at a glance. Solitary trees at cross-roads, windmills, factories, large mansions, monuments and other conspicuous features of the landscape are similarly represented by appropriate and easily recognized figures. Streams, canals, lakes and ponds are printed in blue, and marshes are indicated by blue hatchings, while forests and groves are shown in flat tints of green. Red tints are employed to mark places to be avoided, fine cross-hatching being used for cities and towns, and short, heavy lines, vertical and parallel, for telegraph and telephone lines, vineyards, orchards, quarries, etc. Fortifications are indicated by polygonal scarlet contours, and high voltage electric wires by barbed red lines.

Aviation parks and other favorable landing places are shown in white, and the presence of an airship or aeroplane shed is indicated by a red silhouette of an airship or by that of a rudimentary shed, respectively. The few places where hydrogen can be obtained are indicated by circles.

Railways are indicated by black lines and railway stations by offsets to the lines. Elevations and depressions of the ground are represented directly by shading in bistre and indirectly by numbers indicating altitudes. The mean magnetic deviation of the region is marked in degrees and minutes, and also indicated by an arrow, in the margin of the map.

In Germany a few aeronautical maps have been made

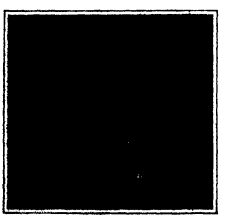


Fig. 6.—The Belgian Cross signal. The point of the arrow is directed northward.

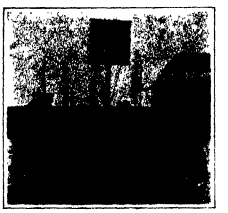


Fig. 9.—Figure-signals by which Farman was kept informed of the distance traversed by him in competing for the Michelin Prize.



Fig. 7.—Portion of a French aeronautical map.

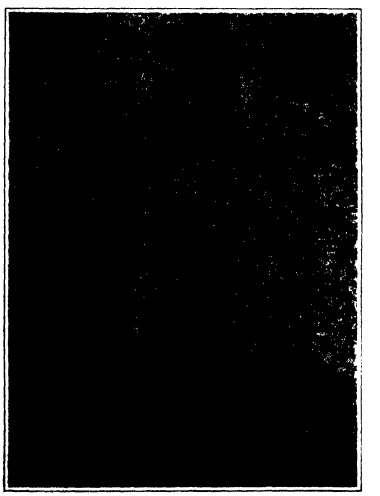


Fig. 8.—German aeronautical map.

THE EARTH FROM THE AIRMAN'S POINT OF VIEW.

by special printings of the maps constructed by the Royal Prussian Land Survey, and it is planned to extend the system over the whole country The scale is 1 to 300,000, and the elevation of the land is indicated by the ground tint of each part of the map, according to the following scheme

Elevation in Meters	Color.
0— 250	white
250— 500	orange yellow
500— 750	raw sienna
750—1,000	burnt sienna
1,000—1,500	lilac gray
1,500—2,000	dark lilac gray
2,000—2,500	dark violet
2,500—3,000	light violet
Above 3,000	white

Contour lines of three types, continuous, interrupted and dotted, printed in sepia, are also used All information which is needed by aviators and aeronauts and not contained in the ordinary Land Survey maps is printed in red, appropriate symbols being employed to designate various objects

Albert Senoucque who was a passenger and observer on the Maurice Farman biplane, with which Eugene Renaux won the Michelin Grand Prix by a flight from Paris to the Puy de Dôme, on March 7th, regards a compass as absolutely indispensable for long flights and says that Renaux steered entirely by the compass during the first sixty-five miles of this journey, which began at 8 50 A. M., when even the river Seine was not discernible at any great distance The compass, of course, should be compensated for the influ-



Fig. 10a.—The roof of one of the military hangars of Camp de Chalons, on which an aeroplane signal is painted.

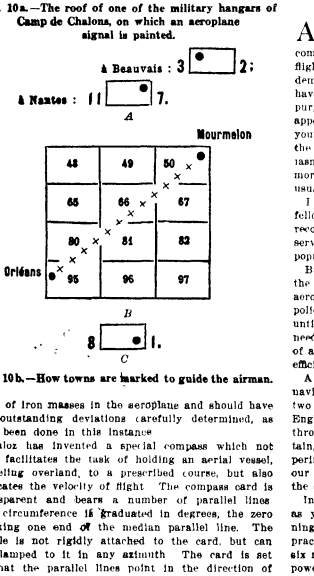


Fig. 10b.—How towns are marked to guide the airman.

ence of iron masses in the aeroplane and should have its outstanding deviations carefully determined, as had been done in this instance

Daloz has invented a special compass which not only facilitates the task of holding an aerial vessel, traveling overland, to a prescribed course, but also indicates the velocity of flight The compass card is transparent and bears a number of parallel lines The circumference is graduated in degrees, the zero marking one end of the median parallel line. The needle is not rigidly attached to the card, but can be clamped to it for any azimuth The card is set so that the parallel lines point in the direction of the prescribed course and the vessel is so steered that the image of the landscape thrown on the transparent card by a lens beneath, moves across the card in the direction of these parallel lines The velocity is determined by means of two lines which intersect these parallels at right angles. From the time which a conspicuous point in the image of the landscape occupies in passing from one of these lines to the other, in connection with the height of the vessel above the ground, as determined by the barometer, the speed of the vessel is easily computed, for the distance between the lines corresponds, in the image, to a real distance of 100 meters, when the instrument is 100 meters above the ground

Mr A G. Marquis, of Rochester, N. Y., has invented a compass with a south-pointing needle and a card which is attached to the frame instead of to the needle, and is marked with the points of the compass in reversed order. When the needle and card are viewed by reflection in a mirror inclined 45 degrees to their plane, the card appears to remain stationary and the needle appears to point in the direction in which the vessel is moving. (SCIENTIFIC AMERICAN, March 4th, 1911.) The oscillations of a compass used in aviation should be deadened by flotation or partial immersion in a liquid, or otherwise, and it is also desirable to protect the instrument from the vibrations of the motor. One aviator uses a compass floating on oil in a vessel which is packed loosely in horsehair

Two beacons have been installed at Spandau, near Berlin, for the guidance of aeronauts and aviators at night One of these beacons is a revolving light provided with a Fresnel spherical lens of 7½ inches focal length surrounded by catadioptric rings, of the type commonly employed in lighthouses The rays which are emitted directly and obliquely downward are brought above the horizon by a reflector and a series of prisms The illuminant is acetylene, obtained from the steel cylinders in which it is sold in condensed form The light is revolved by a turbine operated by the pressure of the acetylene, which passes through the turbine on its way to the burner. The consumption of acetylene is about 8 gallons per hour, and the range of the light is about 10 miles. The range can be doubled by substituting an electric arc and a lens of 12 inches focal length

The smaller beacon is illuminated by 30 incandescent electric lamps of 50 candle-power each, arranged in six circuits, each of which consumes 6 amperes of current. A triphase current of 220 volts is employed The light is stationary but intermittent, the circuit being made and broken by an automatic interrupter at intervals of two seconds. The range of the light is about 1,600 feet.

Naval Aviation

By Capt. W. Irving Chambers, U. S. N.

A SHORT time ago, when flights were made in perfect weather only, the navy regarded aviation with complacency Now that the greater possibilities of flight under average weather conditions have been demonstrated, a majority of our officers are eager to have a hand in the development of aviation for naval purposes, and the fascination of aerial navigation now appeals so forcibly to the spirit of daring in our young officers and men, that our chief difficulty in the future may possibly be so to temper their enthusiasm for flying as to insure the performance of other more necessary and more important duties with the usual degree of efficiency

I have not the least doubt that these fine young fellows would soon be capturing altitude and other records if allowed to do so, and that to advocate conservatism in aviation now, in the face of its present popularity, will seem almost heretical to them

But a certain amount of conservatism, at least in the naval branch of aviation, is imperative, and, as aeroplanes are quickly made, it seems to be sound policy for the navy to make haste yet a little slowly until the machines are better adapted to our special needs or, at least, until we have a sufficient number of aviators trained to use them and to measure their efficiency under service conditions.

A conservative policy is evidently that of foreign navies also, but it is known that France has already two naval aviators and one naval aeroplane, that the English navy has two naval officers under instruction through the courtesy of the Aero Club of Great Britain, and that Italy, inspired by some aeroplane experiments recently made here, in conjunction with our ships, is about to develop a suitable machine of the class that we have already evolved in this country

In fact, although the United States Navy does not as yet actually own an aeroplane, our small beginnings in the development of naval aviation, or the practical efforts that we have made within the last six months have attracted the attention of other naval powers, and we will doubtless soon learn of great advances in the improvement of aeroplanes for naval use generally.

It was only last summer that demonstrations of air flight in this country made it seem probable that aeroplanes could be used from a ship. At that time the principal factor in the general development of aviation seemed to be the stimulus afforded to aviators by substantial money rewards for exhibition flights, and Mr Eugene Ely deserves special credit for cheerfully and enthusiastically entering into the spirit of naval aviation without the prospect of any reward whatever.

Mr Ely may be regarded as a pioneer in this branch, although it should be recorded that he might not have been able to attempt his brilliant work under the auspices of any other than the liberal, yet safe, management of Mr. Glenn Curtiss

It was fortunate for us that one school of aviators was ready and eager to co-operate with the navy; for this connection with the Curtiss school led to a series of progressive experiments that have resulted in the production of a naval aeroplane that is almost perfect.

With this machine Mr. Curtiss is able to arise from or alight on either land or water. He can land on water that is comparatively rough. His "Triad" can be hoisted in and out like a ship's boat and, in accordance with plans already perfected by Mr. Curtiss, we will probably soon be able to launch this machine from shipboard without the necessity for any special platform or the provision of any extra gear that may not be rigged or unrigged in a few minutes.

In my opinion, Mr. Curtiss has recently done more for the development of naval aviation than any other man in the world and he deserves special honor for his liberality and foresight

The usual policy of aeroplane builders is to make the training of military aviators contingent upon the sale of their machines but Mr. Curtiss early adopted the policy of offering to instruct officers of the army and navy in aviation unconditionally, and it is due to this liberality that the navy is ready, now, to train its own aviators, although the money appropriated for independent work in aviation will not be available until the first of July.

The Wright brothers, of whose work the country is justly proud, have also offered to train a naval aviator, and we anticipate the early inauguration of a systematic course of instruction in aviation, entirely under the auspices of the navy, at our own aerodromes, which for obvious reasons it is desirable to have so located as to be accessible to naval vessels.

I regard the development of the naval aeroplanes, or hydro-aeroplanes (the Curtiss type of which has been named the "Triad" from its triple power to function on any of the three elements, air, land or water) as marking an important epoch in aerial navigation

If ever trans-oceanic flight by aeroplanes is accomplished, I presume it will be due to the further development of this class of machine. By its use aerial navigation becomes a matter of comparative safety and a means of delightful pleasure trips and sporting events over water

There is now and always will be sufficient talent in the navy to build its own aeroplanes as well as to operate them and to keep them in the van of progressive aerial architecture. But it is a well known policy of the Department to encourage private industries in the development of war material and, as this policy will doubtless prevail for some time with respect to aeroplanes, I see no good reason for the navy to attempt now to build its own aerial machines It is hoped, however, that this policy will not prevent the navy from making its own laboratory experiments, conducting its own scientific investigation of the problems of aerial naval architecture and engineering and establishing a sound system of standard tests for workmanship. It is also hoped that this policy will not prevent the navy from eventually embodying, in its standard machines, the best points of all makes that are specially suited for naval purposes

From my point of view the principal problem in future flight is the improvement of the motive power. It is the most important because most difficult. Of course, there will be great improvements in the details of shapes and materials and in the assemblage of various other accessories, but we would have been flying fifteen years ago if we could have commanded then the same degrees of efficiency and reliability of the motive power that are at our command to-day. It seems to me, therefore, that there should be some recognized and authoritative government testing for comparing stationary engines and propellers in order to make effective progress in their development. Suitable facilities for this work already exist in the navy. The motors and propellers for future naval aeroplanes will doubtless be thoroughly tested and compared, both in the shop and during flight, at the Engineering Experiment Station at Annapolis and at the aerodrome in that vicinity. In this way the navy may be able to assist in the desired general development.

As for laboratory work connected with the test of models and the materials that enter into the architecture of aeroplanes, the government model plant at the navy yard, Washington, is already well equipped for prosecuting scientific investigation in this direction. There we have suitable delicate recording instruments, a corps of expert woodworkers or model makers and draftsmen under the direction of mathematical experts, and all under the disciplined organization of the Navy Department, ready to undertake the work almost immediately.

I anticipate that, by the introduction of aviation in the navy, we will be able to develop substantial improvements in certain necessary instruments such as the aeroplane compass, for example, and then we

will be able to add something of value to the science of meteorology. Those of us who were brought up in sailing ships realize that our dependence on the wind and weather sharpened our weather instincts. Aerial navigation will doubtless develop in our future naval airmen a yet keener appreciation of weather indications, through their greater dependence on them, and the meteorological observations of these men will doubtless be recorded systematically.

Advanced Study in Electrical Engineering at the Massachusetts Institute of Technology

THE year just completed at the Massachusetts Institute of Technology has found the graduate study which is provided in electrical engineering with an increasing number of students. Prof. Jackson's lectures on the Organization and Administration of Public Service Companies were attended by a class of twelve graduate students and Prof. Pender's lectures on Advanced Alternating Currents and the Transmission of Power were attended by an even larger number of graduate students. Prof. Wickenden's advanced course in the Design of Central Stations and Distribution Systems has also been in demand.

Besides graduating the largest class from the undergraduate course which the Institute of Technology has heretofore graduated in electrical engineering, one degree of Doctor of Engineering and four degrees of Master of Science were conferred on men taking their major work in electrical engineering.

The applicants for permission to become candidates for advanced degrees in electrical engineering are already more numerous than they were last year, and particularly is this true in respect to graduate students who intend to study the problems of electric railroads, electric transmission of power and the organization and management of public service companies.

The Electrical Engineering Department of the Institute of Technology received an appropriation of $3,000 from the Edison Electric Illuminating Company of Boston to be used in an investigation of the relative operating reliability and cost of electric trucks, gasoline trucks and horse trucking, for the purpose of determining to what degree electric trucks are adapted to compete with gas and horse trucks in the city of Boston. This investigation will cover the cost of delivery of goods in the different ways. It will include all questions which concern electric trucks, including the influence of the different kinds of city pavements on cost of delivering goods, and the effects of different routings of the vehicles. The investigation will be partly theoretical but it will be planned to determine practically what it ordinarily costs to deliver goods under city conditions. This part of the investigation will be accompanied by actual observations extended over a period of many months. At least a year will be occupied in this work and Mr. H. F. Thomson has been appointed Research Associate to carry on the work under the direction of Prof. Pender.

The Current Supplement

CITY life presents pressing and peculiar biological problems. One of the most important is the removing of the city's wastes. By the modern methods of sanitary science, these wastes can be purified and rendered harmless. It is with such methods of protecting the purity of inland and seaboard waters that the opening article of the current SUPPLEMENT, No. 1853, deals.—Prof. Henry S. Jacoby, of Cornell University, writes of recent bridge construction in America.—Dr. L. A. Bauer continues his discussion of Ocean Magnetic Work.—Electric energy is sold to consumers either by contract or at a rate proportionate to the current consumed. In the latter case the current is measured by meters. The various meters employed are described and illustrated.—The fifth of Sir J. J. Thomson's Royal Institution lectures on Radiant Energy and Matter is presented.—Major George D. Squier's paper on Multiplex Telephony and Telegraphy, by Electric Waves Guided by Wires, passes to its second installment.

The Microphone and Hidden Water

THE French inventor Dienert has contrived an application of the microphone to the discovery of underground water. One end of a tube is inserted in the ground, the upper end being attached to the microphone. The sounds of flowing or dropping water are conveyed to the ear from great depths.

In the Marne valley two springs were discovered with this apparatus at a depth of about fifty feet below the surface of the ground. It is believed that the apparatus will be of great service in mining operations, both for indicating the location of concealed springs and for communicating with imprisoned miners.

Correspondence

The Forthcoming Merchant Marine Number

To the Editor of the SCIENTIFIC AMERICAN:

One of the most noteworthy announcements made recently in your paper is the one telling its readers of the forthcoming (July 15th next) issue devoted to the "American Merchant Marine."

When I read this, a thrill goes through my heart; I feel a disgrace, a humiliation, a sense of shame, never felt before. When I was a boy, in Missouri, *some great statesmen* told us in school, out of school, and in the press, how the American clipperships were once seen on every sheet of water of the earth, while now we are suffering as a nation after the civil war, but every American heart should hope *that the future would remedy all this.*

Most of these men, as I now realize, were the old school protectionists, who delighted to believe their own stories and who were then, as their followers are now, disciples of Baron Munchausen.

Yes, Mr. Editor! your July 15th number should prove an awakening, not only among the scientific men of the country, but among all true Americans.

Will this number reveal the actual facts? Or will the facts be colored through Pennsylvania glasses? I hope not! Mr. Munn always stood for the truth and nothing but the truth, such as I have known him for forty-six years. It is the real mission of the SCIENTIFIC AMERICAN to smash the system which caused the destruction of our merchant marine. Every schoolboy, every citizen should learn to detect the fallacies which have been saddled upon this great nation in connection with the merchant marine.

I hope July 15th will be a red-letter day in the history of the American nation. We shall see!

MAX JAGERHUBER.

Turner, Orange County, New York.

Aeroplane Stability

To the Editor of the SCIENTIFIC AMERICAN:

I anxiously looked forward to the publication of your May 13th or "Aviation Number," and have read your admirable production with great pleasure. Being in the profession of civil engineering, and having had the privilege of lecturing on "Mechanical Flight" at numerous occasions, dating from 1904 to the present year, I have watched closely all articles that deal with the stability and adaptability of the flying machine, as these have been the principal lines of my studies.

Your editorial rightly mentions that the most important element in the flying machine is stability, with the conclusion that we shall ultimately come to a type of a machine which possesses inherent stability independent of devices requiring equilibristic skill of the operator.

Particular attention is given to the late Octave Chanute, his constant endeavors and his advocacy of automatic stability, but to my knowledge he never even offered a theoretical solution for stability.

In Mr. Marius C. Krarup's article, he refers correctly to the present flying machine as "in part a flying machine, and in part a death trap," and says that "It is without the addition of a single new fundamental idea to supplement or correct its original design." He asks, "What does the engineer say, the man whose profession it is to compare the creations of inventive genius with the data of applied science?" He further states, "Suppose we recommend that inventors work a little harder, and invite imitators to retire from their pernicious activity."

In Mr. Marius C. Krarup's article, he refers correctly to "Stability of the Flying Machine," he says that "the common dihedral angle of the two halves of the main planes to each other, and of the main planes to the keel or tail, give a measure of automatic stability that is now widely understood."

Using the above extracts for the basis of this letter, as an engineer I desire to strongly advocate the necessity of serious study by the inventor and engineer for the accomplishment of stability and adaptability of the flying machine, if the universal use of the same is desired. I agree thoroughly with your statements that it is time to stop imitations, and to work on lines that are founded on better engineering principles.

In the first place, the construction of the machine itself undoubtedly can be greatly improved, by following the well-known forms of truss construction, whereby diverging struts should supplement vertical struts as in the present machine, thereby doing away with the cross chords that tie the present structure together, and in a measure hold their separate parts in rigid relationship to each other. The modern tubular steel is admirably adapted for the construction of the flying machine, and to my mind may be used to the exclusion of wooden braces, with their weak joints and connections.

My studies on mechanical flight have led me to design a machine, whereby automatic stability is theoretically obtained by constructing the wings of either side as separate structures, and pivoting them on the central longitudinal line. The wings of the machine during propelled flight would be mechanically held in a horizontal position as with the present machine, having a very slight, if any dihedral angle, but in case of loss of forward propelled motion or stability, the wings would be automatically raised, as in natural flight, leaving the weight of the body and central portion of the machine below the upraised sustaining areas. This would bring the machine to earth in an upright position, with retarded motion. This proposition is of the simplest construction, the shaft of the engine, being the pivotal axis of the wings.

Together with this theoretical solution for automatic stability, I have furthermore advocated the necessity of adaptability, whereby a machine may alight and travel on the water as would a motor boat, or alight on and travel over land, as would an automobile. This may be accomplished by simply attaching below the sustaining areas spherical or cylindrical rotating hollow floats, further eased and made buoyant by being encircled with modern pneumatic tires.

In promoting the art of mechanical flight, an engineer or inventor is handicapped in the development of his ideas, unless he is endowed with the necessary finances for constructing the same; and I find that publications, as well as individuals, make it very hard for one to develop meritorious propositions of this kind, by insisting upon the inventor or engineer proving his theories before the necessary financial assistance is given.

In reference to your list of the $1,000,000 in prizes being offered, I find no prize available for the development of stability and adaptability in the flying machine.

A prize of $25,000, to be handled by the SCIENTIFIC AMERICAN, in the development of that part of the art, would do more for the advancement of the flying machine toward universal use than the entire $1,000,000 offered, as recounted in your issue.

In these experiments calling for construction and practical demonstrations of the theoretical propositions a good rule to follow would be that unless the theoretical proposition could be eliminated by the judges handling the fund, it should receive the assistance of the fund in the construction and demonstration of the machine. J. EMERY HARRIMAN, JR., C. E.

Boston, Mass.

Waterspouts in Nantucket Sound

To the Editor of the SCIENTIFIC AMERICAN:

In the current issue of the SCIENTIFIC AMERICAN I read with much interest the article on "Waterspouts." Nantucket whalemen, returning from long voyages, frequently related thrilling experiences with waterspouts in the tropical zone, but it was not until the summer of 1896 that the islanders themselves had the privilege of viewing one of these phenomena, for it is rarely that a waterspout has been seen in northern waters. In fact, the spout which made its appearance in Nantucket Sound in 1896 is said to be the farthest north of any on record.

This waterspout appeared in the Sound midway between the islands of Nantucket and Marthas Vineyard, near the Cross Rip lightship, on the afternoon of August 19th, 1896, and I have an excellent photograph of it in my possession. The waterspout accompanied an ordinary thunderstorm, and its progress was noted by the Weather Bureau officials on both islands, the data being on record at the Nantucket station. It first made its appearance at 12 40 P. M., when a tongue shot down from a dense black cloud, rising and falling a number of times. Suddenly a second tongue seemed to leap out of the water and joined that hanging down from the cloud. Twice the waterspout parted, but it joined together again almost instantly, the phenomenon continuing in plain sight of the residents of Nantucket and Marthas Vineyard islands for half an hour.

The spout apparently had no side motion, and it was surrounded by a flat calm, extending over a radius of several miles. A small schooner and a catboat were becalmed within a mile of its base, and those on board the vessels stated that the heat experienced was very oppressive. When the spout broke a cool summer breeze sprung up in the Sound, and the surrounding waters seemed to be full of cross currents and "eddies."

Nantucket sea captains who witnessed this phenomenon stated that the spout was the most pronounced of any they had seen, even in the warmer climes. This is the only time a waterspout is known to have made its appearance in Nantucket Sound.

Nantucket, Mass. HARRY B. TURNER.

Sailing the Seven Seas in a "Cockleshell"

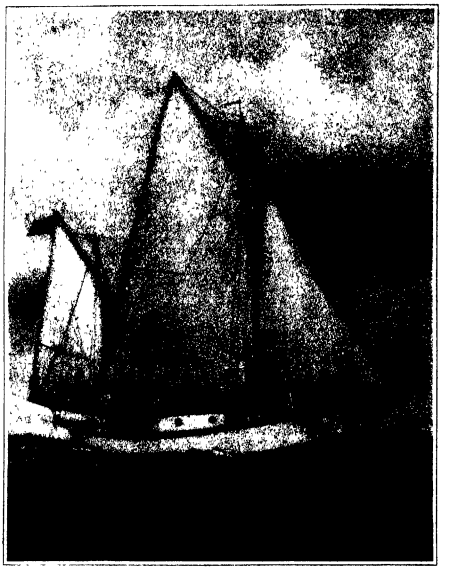
Two Diminutive Yawls Have Dared the Dangers of the Atlantic and Pacific Oceans

BECAUSE of the daring with which their skippers have sailed them out upon broad and deep waters, and braved the perils of storm, fog, and hidden rocks, two diminutive vessels, the "Seabird" and the "Pandora," are now very much in the public eye.

The first of these craft to attract attention, at least on the Atlantic seaboard of the United States, was the "Seabird," a tight little yawl measuring 25 feet 9 inches in length on deck and eight feet in beam, with a draft of the body of the hull of not much over eighteen inches, and a draft to the bottom of the keel of about three feet. At a normal loading the length of the waterline of the "Seabird" is about twenty feet.

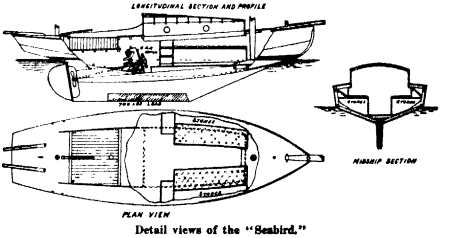
The "Seabird" is one of several designs for small boats which our esteemed contemporary the *Rudder* has published during the past dozen years or so—small, serviceable craft, designed with an eye to comfort, safety, service, ease of construction, and, last but not least, low cost. From these various designs, scores of boats have been built by amateur hands, not merely in the United States, but throughout the world, and, judging from the published stories of their construction and subsequent service, they seem to have been successful and popular. Mr. Thomas Fleming Day, the editor of our esteemed contemporary, the *Rudder*, built a boat from one of these designs as far back as 1904, and named her the "Seabird," and by line and wash drawing our artist has given the SCIENTIFIC AMERICAN readers an opportunity to inspect the craft for themselves. Those of them who are nautically inclined and know something about boats will see that this craft can be easily and cheaply built from such simple materials as can be obtained from the stock of any good lumber yard. In cross section the "Seabird" represents in her underwater body a greatly flattened V, with top sides which rise straight from the bilges, which are at the waterline. The "Seabird" is decked throughout, and the raised cabin roof provides as much head-room as one can reasonably expect in a shallow-bodied boat of this form. There is storage room for spare sails, etc., in the forecastle, and there are two berths in the cabin. The space between the berths and the ship's side and underneath the berths has been utilized for "ship's stores."

The "Seabird" of 1911 differs from the "Seabird" as built in 1904. At that time she had a shallow keel, through which ran a centerboard. As now reconstructed, the centerboard has been taken out and the keel has been lowered until the boat has a normal draft of about three feet. Furthermore, in the bottom of the keel are seven hundred pounds of lead ballast. Another important change has been the installing of a three horsepower motor, which will serve to drive the boat at four knots. Under sail and motor power combined she is expected to make about six knots. The fuel consists of thirty gallons of gasoline and fifty gallons of kerosene. The consumption when power alone is used would be about ten gallons a day; but of course it is intended to use the motor only when there is no wind, or the wind is very light, and, if progress is slow, when the winds are ahead.



Length, 25 feet 9 inches; beam, 8 feet; draft, 3 feet. Carries an auxiliary 3 horse-power motor. Speed, under power, 4 knots; under power and sail, 6 knots.

The yawl "Seabird" in which Editor Day is crossing the Atlantic.



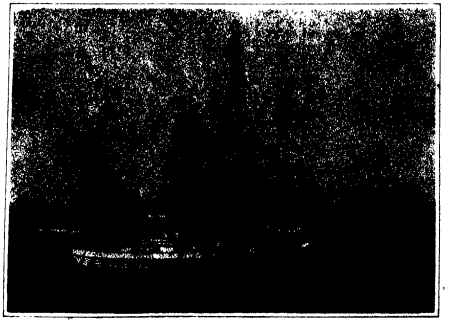
Detail views of the "Seabird."

The "Seabird," it will be observed, is rigged as a yawl, with jib, mainsail, and mizzen. The yawl rig is recognized among yachtsmen and all sailormen as about the most handy and safe for the smaller craft, particularly when they are exposed to heavy weather and sudden squalls. A yawl whose sail plan is well balanced can be sailed under jib and mizzen, or under the mainsail alone. Under storm jib and reefed mizzen, she is a particularly handy craft in quite a strong blow; and if the wind should rise to the strength of a full gale, all sail may be furled, and the vessel handled nicely under a small trysail on the mainmast.

Public interest in the "Seabird" lies in the fact that she is now sailing across the North Atlantic Ocean on a pleasure trip, if you please, to Rome. The crew of the little craft consists of Mr. Day and two men, it being the claim of Mr. Day that there is no greater danger for small craft, if indeed as much, in ocean sailing than there is in sailing within sheltered but crowded waters, such as Long Island Sound. He believes that the best Corinthian sailors are found among those who strike boldly out for deep water and learn to navigate by sextant and compass. It is largely due to his influence that long-distance ocean races now form a regular part of the summer schedule of our yachtsmen, both on the Atlantic and the Pacific. Notable among these are the races to Bermuda and those from this port to Marblehead.

Mr. Day has always been a firm believer in the sea-going qualities of the yawl, and the present cruise from Boston to Rome on the Mediterranean, is proof that he has the courage of his convictions, even though his craft is so small that Hudson's "Halfmoon" could have stowed her on deck, and not have been greatly inconvenienced thereby. The course laid out for the "Seabird"

(Continued on page 37.)



The 37 foot 9 inch yawl "Pandora" which is cruising around the world.



The "Pandora's" doughty skipper.

SAILING THE SEVEN SEAS IN A "COCKLESHELL"

Automobile Novelties

A Motor Car for Assayers; Psychological Tests for Chauffeurs

Searching for Mines in a Motor Car

HEREAFTER it will not be necessary for the prospector to undergo the hardships of the trail, for a Los Angeles mining man and inventor has set the pace for the twentieth century search for mines. Mr. H. W. Larsson, assayer, engineer, and practical prospector, has built an automobile which is fully equipped for desert travel, and which will not only enable him to carry the comforts of civilization with him on his quest for precious ore, but also to test his sample within an hour after he finds a promising lead, thus saving much valuable time.

This highly original combination of motor car, Pullman coach, and assay office was constructed entirely from Mr Larsson's plans, only the wheels being bought in their finished state, and apparently no detail has been overlooked to provide for the comfort of the travelers. There is a reason for this, as Mrs. Larsson is now accompanying her husband through the southwestern desert The housekeeping equipment is exceedingly compact.

A table folds up against the wall, and when it is let down discloses a small kitchen cabinet and triple cooking outfit, while lockers, china closet, larder, and medicine chest are so arranged as to take up the least possible room Two 20-gallon tanks of water are carried, and that used for drinking purposes runs through chemically cooled pipes and is delivered ice cold The water faucet and glass are conveniently arranged near the driver's seat. This seat, by the way, is reversible, so that at the meal time it can be made to face the dining table instead of the front of the car

The engine is connected with a dynamo which furnishes electric lights for the little home on wheels. Two comfortable berths are arranged so that they can fold up against the wall when they are not in use, and a kind of folding chiffonier is provided for wearing apparel

The automobile is equipped with sliding glass windows and green curtains which insure privacy, while a row of small ventilators extends all the way around the car directly under the roof.

So much for comfort From the utilitarian standpoint, Mr Larsson's plans are no less thorough From his own model was constructed a three-cylinder, two-cycle engine with double friction drive of a proved 33 horse-power This carries the car along at a rate of sixteen miles an hour, which is ample speed for his purpose It also furnishes the power for the electric lighting plant and the ore crusher which grinds his specimens to the fineness of 100 mesh.

The complete ore-testing equipment consists of a rotary flame combination furnace with Cary burner and tank outfit, a Braun pulverizer, and a steel frame Chipmunk crusher.

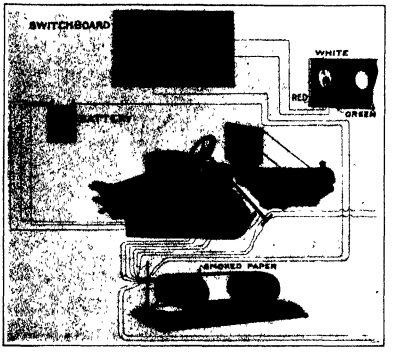
These are all in miniature size, but of course do the actual work required for the prospector, and in addition to this they can be used to demonstrate the efficiency of the same outfit on a large scale, so that in one sense this up-to-date prospector might be called a traveling salesman for the manufacturers of these machines. This, however, is a side issue, and merely indicates how far the modern prospector has departed from the ways of the former generation of burro packers. Four tanks of gasoline are carried, each of ten-gallon capacity. The general appearance of the car is very attractive without being ornate. Its dimensions are, length, 12½ feet; width, 4½ feet, and height, about 7 feet.

In addition to his mining work, Mr. Larsson intends to do an excellent service to his fellow prospectors and desert travelers in marking the trails to water holes along his route. He will also place guide posts indicating the number of miles from the various camps, and the distance will be accurately determined by his speedometer. The metal guide posts, 250 in number, were supplied gratis by F. W. Braun of Los Angeles, and will do much to mitigate the hardships of the trail.

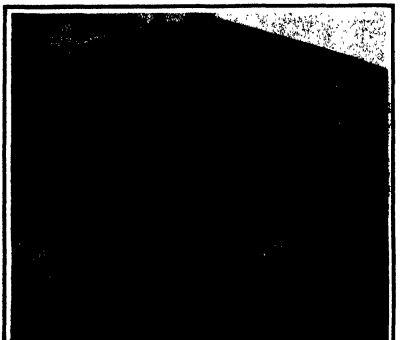
Psychological Apparatus for Testing Chauffeurs

By Ralph Bergengren

ALTHOUGH no definite relation has yet been established between the operation of statute law and the experimental study of human beings by the psychologists, many experts in both fields are coming more and more to believe that psychology will play an important part in legal procedure during the present century. Practically the psychologist has so far taken no part in legal proceedings But he has invented apparatus that can detect the hidden emotions of a witness far more certainly than any unaided cross-examination and that will force the truth from a suspected criminal, without cruelty if he happens to be innocent and with an absolute precision impossible in the ordinary methods of police interrogation To record and measure the hidden feelings of an individual in regard to any given subject is evidently more reliable a way of getting at facts than to ask him questions without any definite method of determining the truth of his answers Herein, it is argued, lies the future of psychology as a practical first aid to law and order



PSYCHOLOGICAL TEST APPARATUS FOR CHAUFFEURS



REAR OF CAR, WITH ORE CRUSHER IN OPERATION

The latest example of psychological apparatus that might be applied to the routine business of a municipality is a mechanism devised by Mr. Charles Sherwood Rieker, of the Department of Psychology at Harvard University, for the purpose of testing the reaction-time of the man behind the steering wheel of an automobile. A reaction-time, in psychology, is the exact space, measured in fractions of a second, necessary for a given individual to receive a given impression and perform the actions suggested by it. Applied to criminal investigation, for example, the criminal, being asked any question that suggested his crime, would answer that question by an infinitesimal fraction of a second more later than he would answer questions without such connection Whatever his control over his features, he would be unable to prevent this infinitesimal slowing up of the mind when the crime was recalled to him And so when applied to the problem of individual capacity to run a motor car the psychological apparatus gets down to conditions that no amount of verbal examination could possibly arrive at Legal qualifications for handling a motor-driven vehicle vary at present in the different States The severest requirement demands that the applicant for a license shall prove that he has driven such a vehicle at least one hundred miles Among the questions most generally asked of such candidates, three are almost universal Do you habitually use, to excess, intoxicating beverages? Have you any mental or physical incapacity or infirmity which would interfere with your management of an automobile? Have you ever been convicted of any offense against any laws in relation to the use of automobiles on public highways?

One hardly needs be a psychologist to see that neither the mere negative answer to these questions nor the fact of his having driven an automobile over a hundred miles proves that an individual should be trusted to run a motor car Candidates are unlikely to admit, or even believe, that they ever use intoxicating beverages to excess. Physical infirmities that may result in motor accidents may also be entirely unsuspected by their possessor The third question has little bearing on the capacity of the individual to run his car, although it may show his attitude toward the law And the hundred miles over which he has driven a car may easily have been a hundred miles of open country road and no test whatever of what will happen when he meets some sudden emergency in a crowded street The really important question is not what the candidate has done but what he is likely to do under the most sudden and unexpected emergencies No man, unless he has long experience with emergencies, can tell how quickly and efficiently he would be likely to meet a new one But the psychological apparatus devised by Mr Rieker answers this question by bringing the man suddenly face to face with the emergency and measuring the time it will take him to meet it with the various controls of his motor car

The apparatus consists of a device for signaling the emergency and another for recording the reactions of the motorist A dummy motor car is provided with the regulation steering wheel, the side throttle that controls the different speeds, the foot clutch whose release throws the machinery of the car immediately out of gear, and the emergency brake In place of the ordinary wind shield the psychological motor car has an opaque screen with three openings and in front of the screen are three electric bulbs invisible to the chauffeur except when one or the other of them suddenly glares at him through an aperture These bulbs, white, green and red respectively, are so arranged that they may be revolved in front of the openings in the screen by means of an electric push button under the finger of the psychologist conducting the experiment. Outside the car, or in the tonneau of a real automobile, if the tests were being made on the road is a cylinder of smoked paper which revolves steadily and is in contact with the end of a tuning fork and almost in contact with four little metal pointers respectively connected by an open electric circuit with the steering wheel, clutch, throttle, and brake

Pressure on the push button that flashes one or another of the electric bulbs in front of the chauffeur sets the cylinder or time clock in motion, and the tuning fork begins tracing a sharply scolloped line on

(Continued on page 35)

Abstracts from Current Periodicals

Phases of Science as Other Editors See Them

The British Naval Airship

At last the British leviathan of the air has emerged from the interior of its hiding place into the full light of day. And it is an immense dirigible, too, indeed the largest in existence. Over 170 yards long, no less than 16 yards in diameter. According to *Flight*: "It has a gas capacity of 700,000 cubic feet, a lift of 21 tons, its engine power is no less than 400-horse power in two equal units formed by Wolseley engines. It can carry twenty-two persons and has cost up to date the sum of $205,000. More than an acre and a half of Continental fabric was employed in the construction of the envelope, and the hydrogen, compressed in cylinders, was brought over from Wolverhampton by the train load at a time.

"During two years this airship has been in course of design and construction, and the lines on which it is built are broadly similar to those of the famous Zeppelin airships that have created so many sensations in Germany. We will at least hope that the English vessel will be more fortunate. Its constructors are the great firm of Vickers, Ltd.

"The characteristic feature of the type to which it belongs is the rigidity of its envelope, which has an interior skeleton framework made of duralumin, the new light aluminium alloy. This framework maintains the shape of an envelope, which is thus not dependent on the gas pressure as it is with airships of the non-rigid type that are intended to be capable of being folded for transport by land.

"Inside the framework of the envelope are seventeen ballons filled with hydrogen, each balloon forming a separate gas-tight chamber of its own, and if deflated by accident would not affect the others. Outside the framework is a covering of fabric, the appearance of which is somewhat distinctive owing to the upper part being silver gray and the lower half yellow in color. The upper part is as fat as possible a non-conductor of heat, and thus minimizes the effect of the sun's rays on the expansion of the gas. The lower part, on the other hand, is a conductor of heat and thus facilitates the proper equalization of temperature between the gas and the atmosphere to be carried on in a normal manner.

"In accord with the most modern theories of streamline form, the envelope is cylindrical in the middle, with tapering extremities. The nose is blunter than the tail. On the tail of the envelope or hull, as it may be termed because of its rigidity, are the directive organs, consisting of four stabilizing fins (two vertical and two horizontal), two sets of quadruplane rudders and two sets of triplane elevators. There is also an elevator under the bows and another rudder right under the stern, these latter being both situated next to the cars. Beneath the hull are two 20-foot cars or boats joined by a gangway. In front the engine drives two four-bladed propellers, carried on outriggers beneath the hull; at the stern there is a single two-bladed propeller.

"Water ballast is employed and the estimated speed of the airship is 30 miles per hour. For mooring purposes the bows of the airship are anchored to a mast rising from a kind of raft, which also carries a great net screen like a sail. The mesh of this screen is sufficiently close to break down the force of the wind without being itself torn away in the process, and the anchorage is such that the airship and its screen can veer round so as to keep head on to the wind. The airship is in charge of Capt. Sueter, who has under him Lieuts. Usborne and Talbot. The present ship to which she is attached is the cruiser 'Hermione.'

"It took 300 bluejackets less than an hour to haul the airship out of her shed and get her safely moored in Cavendish Dock in the early hours of Monday morning, May 22nd. To be precise the performance commenced at ten minutes past four, and was all over long before most people had waked from sleep. One of the most striking sights in connection with the launch was the sudden appearance of sailors on the very top of the envelope, where there is a prepared gangway, and access to which is obtained by means of a rope ladder through the center of the envelope itself."

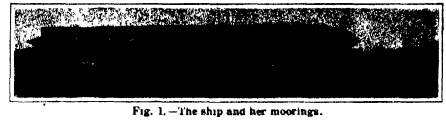


Fig. 1.—The ship and her moorings.

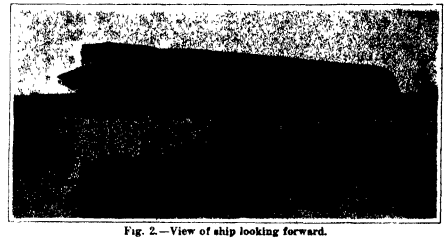
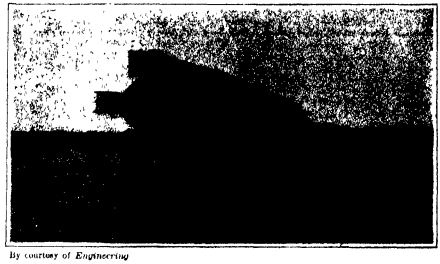


Fig. 2.—View of ship looking forward.



By courtesy of *Engineering*

Fig. 3.—The stern of the ship.

THE NEWEST OF DIRIGIBLES

Observations on Scientific Management

"MODERN watches are marvels of intricate and perfect construction," says Mr Harrington Emerson, the efficiency engineer, in the *Engineering Magazine*. "Any child can push a stick in the ground and by the position and length of the shadow determine approximately the time. A clepsydra or water clock, an hour glass, physical material leaking away at a uniform rate, was a decided advance at guessing on the time in the dark, or the time for boiling an egg. The early clocks with their pendulum escapements required many months of experimental test before length of pendulum, meshing of wheels, amount of weight, were adjusted to one another. There are as many different kinds of watches and clocks as there are locomotives; but each is perfect with a perfection so great as to be almost inconceivable. The jewelled bearings, the almost microscopic yet mathematically perfectly shaped teeth of the wheels, the hair spring, the balance wheel, each is perfect in itself, perfectly related to the others, until the whole is also perfect. This is not all. Delicate, automatic machines are made which turn out these perfected parts so exactly alike as to be interchangeable. Turret lathes and screw machines, automatic machines in general, were earliest adapted to clock and watch making, and from that extended to larger and heavier parts, often beyond the point of economy; for in watch screws the material, even if of gold, would not amount to very much, the perfection of finish being all important, but as the weight of material grows with the cube of its linear measurement, we cannot afford to make on automatic machines crank pins or even knuckle pins for locomotives, it being too expensive to cut down the solid bar.

"It would take no more thought and work to standardize operations for building a locomotive than for building a watch. The difference is that watches are turned out by the hundred thousands and locomotives only by the thousand; but this difference is not as great as it seems, for a watch movement may average $5 in value and a locomotive $15,000, so that one locomotive corresponds to 3,000 watches, and we have not hesitated to undertake the work of designing each separate locomotive part, we need not fear the labor of standardizing the operation of manufacture for each separate locomotive part.

"Another instance of standardized operation is the printing of a book. The old writers were individualists; there was no standardized operation. Each made not only the size of the letters to suit himself, but also their forms, took pride in not being like other scribes; each spelled the words his own way, each used his stylus or brush as he preferred, preparing his own ink, his own papyrus or parchment. Now we buy half a dozen newspapers a day for a cent each, we buy a dozen magazines a week for 10 cents each, we buy a hundred books a year for a dollar or two each. Scarcely any two books are alike; there is far greater variation than in locomotives or watches; but each book is made up and printed with standardised spelling, standardized lines, standardized pages and standardized signatures; even the book itself approaches a standard in size. The ink is made to suit various fluctuations in the weather, the paper is made to suit the quality of the book in press. While printing is as yet standardized in a rudimentary way only, while it affords a field as large as any manufacturing business in the country, it has nevertheless in certain limited directions standardised operation to an advanced extent.

"In the watch, in the book, we have the standardised operation as to the manner in which it shall be carried out; but there is another element—that of individual skill.

"Two men may both show a model wall of brick, yet one man may have laid 3,000 bricks a day, the other man only 300.

"So true it is that one man and one intellect properly qualified for the particular undertaking is a host in itself and of extraordinary efficiency.' Thus wrote Polybius, 212 B. C., in describing the work of that great engineer Archimedes, who, by his individual genius, flung rocks from catapults at the approaching besieging ships, who constructed cranes that let down grab hooks, lifted the ships out of the water, and turning them over, let them fall to destruction.

"Horses have trotted and trotted well for many centuries, but it remained for Americans to figure out that the value of a minute might be rated at $3,000,000, and that to eliminate the minute, to evolve the mile-in-two-minute horse from the mile-in-three-minute horse would be worth this amount. Prizes were offered to crack trotters for beating their own record, $10,000 for the fifth of a second, and there are 200 fifths in a single minute. It was not only the horse that was developed; it was also the American stop-watch spirit, so that our fire fighters, witness every movement for men and teams has been standardized, are able to charge across the threshold of their fire-house 30 seconds after the gong has sounded.

"At an international contest in Berlin several years ago it took the English team over two minutes and the German team over eight minutes to make a start. This is quite a contrast as compared with the American performance.

"Now aeroplanes have come; and at the international meet in Belmont, true to our national virtues and our national faults, we were prepared to time the flights to the hundredth part of a second, but with a year's warning we had no machines. Wright, with 'to fly' and we lost to the foreigners because we were unprepared."

The Movement of Soil Material by the Wind

UNDER the above title the United States Bureau of Soils has just published, as its Bulletin No. 68, a monograph by E. E. Free, which, including an enormous bibliography of æolian geology by Messrs. Stuntz and Free, comprises 372 octavo pages. This work brings together, correlates and summarizes practically everything known in regard to æolian geology, so far as that subject concerns the student of soils.

While the activity of the wind as a geologic agent has long been fully recognized, its action on the soil has not heretofore been adequately treated as an agronomic problem. It is, however, a most important factor in the complex system of soil movements affecting soil fertility. The soil of any particular farm or field is continually changing under the action of the wind. This action, when moderate, is beneficial to fertility; when excessive, it is one of the serious obstacles to successful agriculture, and must be controlled by various expedients, such as windbreaks, cover crops, rotation schemes, etc. This matter is important not only to the tiller of the soil, but also to the builder of railways and highways, the irrigation engineer, and many others.

Such is the important economic problem that Mr. Free has undertaken to discuss, but he has far exceeded his theme, and has produced a memoir replete with interest to the physical geographer, the geologist, and the meteorologist; for his work is a digest of existing information concerning the solid content of the air; its composition and sources, the mechanism of its transportation; and the many effects of its removal from and deposit upon the earth's surface. The scope of the work may be judged from the following principal headings in the text: Heterogeneity of soils; translocating agents in general, the limitations of water translocation; wind translocation; the mechanics of wind translocation; drifting sands and sand dunes; dust storms and dust falls; the continual drift of soil material with the wind, true atmospheric dust; geologic formations of æolian origin, volcanic dust as soil material, wind transport of vegetable matter; translocation in general, excessive blowing of the soil.

In one respect, in particular, Mr Free has set an admirable example to the writers of scientific monographs. His text is supported at every step by copious and well-nigh exhaustive references to the sources of his information. These references number many thousand; so that under each topic discussed the reader will find a complete bibliography of the same; and the references are repeated in an amplified form, alphabetically arranged by authors, at the end of the book As a contribution to scientific bibliography this work is almost unrivaled among recent official publications; while the text is an invaluable summary of the immense body of literature upon which it is based.

The Prevention of Malaria[1]

AMONG the most striking successes which preventive medicine has achieved in recent years is the very extensive subjugation of malaria as the result of the recognition of a certain breed of mosquitoes as the carriers of the disease The subject, on which there is now considerable literature, has been treated in collective form in a hand book recently published by Prof R. Ross, and reviewed in a late issue of *Science Progress*. The reviewer, E. A. Minchin, says in part:

"Prof. Ronald Ross, poet, mathematician, and apostle of tropical sanitation, gives us in the first half of this book the fruit of twenty years' research and experience with regard to the causation and prevention of a disease which, on his estimate, causes 'between a quarter and a half the total sickness in many tropical countries.' The remainder of the book consists of reports from those who have put Ross's principles and methods into practice in every part of the globe; their results afford a brilliant testimony to the immense value to humanity of the modern discoveries regarding the etiology of malaria, a subject in which Ross himself led the way and broke entirely new ground.

"The aims and objects of this book are essentially practical and utilitarian; it is intended to set forth concisely and in a form popularly intelligible the relevant facts concerning the natural history and causation of malaria, in order to show clearly how the disease may best be prevented and eradicated. It is, in short, a manual of instruction for medical men, sanitary officers and administrators upon whom may fall the task of combating malaria in some part of the globe. For this reason the more purely scientific aspects of the malarial problem, such as the marvellous and complicated life history of the parasite in its two hosts, vertebrate and insect, are dealt with as briefly and simply as possible.

"The malarial theorem, as Ross aptly terms it, may be stated briefly as follows. Malaria in man or animals is a disease caused by a minute parasite which lives and multiplies in the blood, passing its trophic phase within the red blood corpuscles The parasite is propagated from one vertebrate host to another by the agency of certain mosquitoes, which, on sucking the blood of an infected vertebrate, take various stages of the parasite into their stomachs with the blood; one stage of the parasite resists the action of the digestive juices of the mosquito and passes through a sexual process of generation and multiplication within the body of the mosquito, the cycle ending after some days with the production of many thousands of minute germs ('protospores,' Ross) lodged in the salivary glands. If the mosquito then succeeds in biting a vertebrate of the right kind, that is to say, of the kind which is a specific host of the parasite in question, the germs pass down its proboscis and are inoculated into the blood, thus bringing about a fresh infection of the disease Every statement made in the foregoing sentences is based on rigorous experiment or accurate microscopical investigation It only remains to add that the various species of malarial parasites are specific to certain hosts, vertebrate or insect, those of birds, for instance, can only be transmitted by mosquitoes of the subfamily Culicine; those of men only by the subfamily Anophelinæ

"The principles of malarial prevention depend on the facts stated above, their aim is to interrupt the complex chain of circumstances upon which the existence of the parasite depends If the parasite cannot pass from man into the mosquito, or from the mosquito into man, it becomes extinct with the death of its host, if not before Hence there are three general principles of prevention (1) *mosquito-reduction*, that is to say, measures undertaken with the object of destroying mosquitoes or their aquatic larvæ, or of abolishing or reducing the pieces of water suitable for them to breed in; (2) *treatment* of human beings with quinine, either with the object of reducing the cases of sickness, or in order to enable the healthy to resist infection, should they chance to be bitten by an infected mosquito, (3) *protection* of human beings against mosquitoes by various methods, especially by rendering houses proof against these insects Any of these three methods is sufficient to extirpate malaria completely, if carried out thoroughly If, in a given locality, the Anopheline mosquitoes are exterminated, or if there are no infected persons for them to bite, or if they are prevented from biting human beings, the disease cannot continue. But in practice it is always impossible to carry out any of these methods completely and it is necessary to rely upon a combination of the three The best results are always obtained by mosquito-reduction, since it can be effected by administrative regulation, while treatment and protection depend mainly on individual effort—always difficult to control or enforce.

"Such are, very briefly, the main aspects of the problem of preventing or extirpating malaria, but many pages are required to set forth the intricacies and complications of the question

"Turning to the second half of the book, it is impossible to give in a brief space an account of the many anti-malarial campaigns in all parts of the world that are described and reported upon by twenty-one different writers It must suffice to state briefly the results obtained in Ismailia, that most striking example of the practical importance of Ross's researches and of the efficacy of his methods, as set forth by Mr H C Ross

"The town of Ismailia was founded by M de Lesseps, who intended it to be a model city, a thriving port and the headquarters of the Suez Canal Company It progressed rapidly, rising to a population of 10,000, until in 1877 malaria made its appearance, 800 cases being notified in that year. From 1885 to 1902 the number of cases annually was seldom much below 2,000, and in 1891 it rose to over 2,500, more than one-quarter of the whole population In 1902 an anti-malarial campaign was started under the auspices of Prof Ronald Ross, directed chiefly toward the extermination of the mosquitoes. A marsh near the town was drained; pools were filled up and a mosquito brigade was organized consisting of a European foreman and two natives The duty of the brigade was to visit every house once a week, to treat the cesspools with petroleum, in order to kill the mosquito larvæ; to empty all standing vessels or tubs containing water, and to clear all irrigation channels of reeds, so that the water could flow swiftly. Penalties were imposed on the inhabitants if they did not report to the authorities the existence of untreated collections of water. The work cost $10,000 the first year and about $5,000 a year subsequently. For this relatively trifling outlay the most remarkable results were obtained The number of cases of malaria fell at once, in 1903, to 300; in 1904 there were 90 cases, in 1905, 37, since then no fresh cases of malaria contracted in Ismailia have occurred, the disease is stamped out It is necessary, however, to continue the preventive measures, since if the mosquito brigade stops work for a week the mosquitoes return, and there is always the danger, in that case, of a recurrence of the epidemic through infected persons from without coming into the town

"Nothing shows more clearly than the case of Ismailia the possibility of combating malaria effectually in any locality if anti-malarial measures, especially that of mosquito-reduction, be carried out rigorously The failure to obtain similar results by similar methods in other places must be ascribed mainly to the obstacles which stand in the way, of which the chief are ignorance and blind resistance to administrative efforts on the part of the people, or official apathy and parsimony on the part of the government classes." Prof Ross speaks out strongly on these subjects, as he has done frequently before It is to be hoped that this book will be widely circulated among medical men and administrators in the tropics, and that it will lead to a proper understanding of the measures to be taken against one of the greatest obstacles in many lands to civilization and progress

[1] *The Prevention of Malaria.* By Ronald Ross, K.C.B., F.R.S., Major, I.M.S(ret.). With Contributions by Prof. L. O. Howard, Col. W. C. Gorgas, and others. (Illustrations, xx + 660.) (London: John Murray, 1910.)

Visual Sensations from the Alternating Magnetic Field

FOLLOWING on the experiments reported by Prof Silvanus P Thompson, it is interesting to note the further research in this subject pursued by Mr. Knight Dunlap, an account of which appears in a recent issue of *Nature*

"Prof Thompson subjected the head to the influence of an alternating magnetic field, which was obtained by means of a coil of thirty-two turns of stranded copper conductor having an internal diameter of 9 inches and a length of 8 inches The coil was supplied with a current the maximum value of which was 180 amperes at a frequency of fifty cycles per second

"On inserting the head in the coil under these conditions, a flickering light sensation was obtained, the sensation being more clearly defined in the peripheral part of the field of vision

"The object of the further experiments by Mr Dunlap was to ascertain whether or not these sensations were due to idio-retinal light, under the suggestion of the hum of the coil caused by the alternating current.

"A coil was constructed which gave a field of approximately the same density as that obtained by Prof. Thompson, and identical results were observed

"In order to ascertain whether the effects are due to idio-retinal light and suggestion, some experiments were carried out in which suggestion was eliminated to the fullest extent

"In these tests the transformer was placed near the coil, so that the hum of the coil was completely drowned by the noise of the transformer Arrangements were made whereby the current could be switched from the coil on to a resistance, the strength being maintained constant

"The subject's ears were plugged up, and a telephone receiver connected to the transformer was hung on the coil

"Under these conditions it was absolutely impossible to tell by the sound whether the current was on or off the coil, each of the observers was able, however, to identify the flicker with absolute precision when the current was switched on to the coil.

"With a field alternating at a lower (twenty-five cycles per second) frequency, it was found that sensation was much more pronounced and intensely disagreeable, the whole visual field quivering as if illuminated by a rapidly intermittent light

"The effect was at all times very intense when the side of the head was presented to the coil, but on looking into the coil it practically disappears From this Mr. Dunlap infers that the sensation is due to currents induced in the optic pathway, he states that whether these currents excite the occipital cortex directly, or excite the retina primarily is a matter for conjecture, the fact that the flicker is produced by alterations faster than the fastest flicker from normal light stimulation being, it is stated, no evidence for the non-retinal character of the flicker in question

"It is stated that there was no evidence to show that there was a definite arousal of visual sensation by the alternating field, the effect appeared more like an alternate intensification and inhibition of whatever sensory process was already in progress That is to say, the idio-retinal light which is present before the current is turned on is increased and decreased alternately."



[The Editor of Handy Man's Workshop will be glad to receive any suggestions for this department and will pay for them, promptly, if available.]

A Dangerous Muffler

To the Editor of Handy Man's Workshop

IN Handy Man's Workshop of June 10th there is a description of a muffler for gasoline engines, which may work all right and certainly will be a good silencer so far as the noise from the exhaust is concerned, but some day the engine will get to missing fire—they all do it some time—and then the unburned gases will be forced from the engine into the barrels. This may continue for a time and then a weak charge in the engine will be fired and the fire will be communicated to the unburned gas in the exhaust pipe and from that into the barrel and away will go the barrel as if a large charge of powder had been exploded. I have long known of the danger in such cases. Only a few years ago a party had an engine in one of the buildings I now own, and had placed a large box under the flooring into which the exhaust from the engine went, passing thence to the outside. Then the batteries became weak and the engine began missing, and a little later the gas in the box exploded. It tore up about 15 feet square of floor and broke nearly every glass in the lower story of the building, 24 by 60, and did a lot of other damage. It hurt one workman considerably, but did not kill any one, which was considered very lucky.

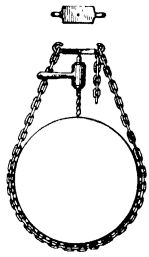
H. L. CHAPMAN

Marcellus, Mich.

A Good Substitute for a Drill Post

By R. C. D.

THERE are times when one is in a quandary as to the best way of setting up a drill post or "old man," as it is sometimes called. This is particularly true when one has nothing but a curved surface on which to attach the base of the post. To overcome this trouble when holes are to be drilled in cylindrical objects such as metal posts, poles, boilers, etc., one may use a chain attached to a metal plate shaped as shown in the accompanying illustration. This plate has hooks forged or attached to its ends as shown, and to one of these one end of the chain is permanently secured. The other hook is made just large enough for the links of the chain to pass over it freely. In this way the device is made adjustable on objects of various sizes. The method of using the device in connection with a ratchet drill is clearly shown in the illustration.

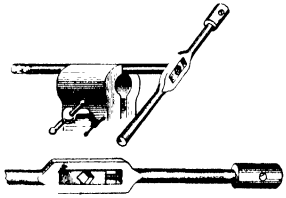


Substitute for a drill post.

Reducing the Size of Tubing

By F. C. I.

IT often becomes necessary to reduce the size of copper tubing so that it will enter a connection which does not admit of being reamed out to a larger size. If the tubing is filed down to fit it weakens the connection. The tubing is easily and neatly reduced by means of a tap wrench, which is placed over the end and tightened as it is rotated. The tap wrench should be tightened gradually, or it will crimp the tubing.

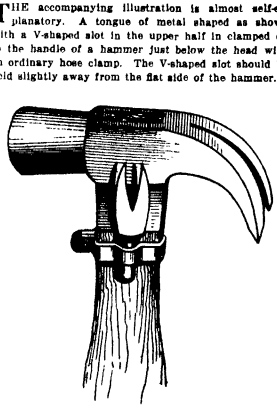


Reducing a tube with a tap wrench.

Nail-holder for Claw-hammers

By W. J. C.

THE accompanying illustration is almost self-explanatory. A tongue of metal shaped as shown with a V-shaped slot in the upper half in clamped on to the handle of a hammer just below the head with an ordinary hose clamp. The V-shaped slot should be held slightly away from the flat side of the hammer.



Nail-holder for a hammer.

When it is desired to drive a nail in a location where both hands can not reach, for instance, above the head or to the right or left, when standing on a ladder, the nail is placed in the slot, with the head against the hammer head and the point extending to the side. A sharp blow starts the nail, and on withdrawing the hammer, the nail can be driven home.

Centering and Reboring Engine Cylinders in a Lathe

By H. C. Urbaner

TAKING for granted that our friend wishes to rebore cylinders in an ordinary lathe, I think he will find the following simple method very helpful.

First, fit a hardwood block (2 by 4 preferred) into each end of the cylinder so that it will hold a rigid position. Now take a pair of hermaphrodite dividers and accurately fix a center into these blocks. Then with a three-quarter inch drill, or an inch drill, bore holes through these blocks at the centers described so that they will be in line with each other. Now fit a rod through these blocks so that it will extend far enough out of each end of the cylinder to meet the lathe centers without interference of projections of the cylinder. Here I may state that the centered blocks alone will be sufficient on a cylinder having both ends fitted with a head.

Next lay the cylinder on the slide rest and with hardwood blocks. If iron blocks are not available, block it up until the centers previously made in the rod will be accurately in line with the lathe centers, when the cylinder is lightly bolted and clamped to the slide rest. This is the all-important step of the entire process, and must be done accurately with whatever material there is at hand.

Now for a boring bar. This bar should be of round steel shafting and sufficiently longer than twice the length of the cylinder so that while doing the work the cylinder will not strike the dead or live centers of the lathe.

It should be at least two and one-half or three inches in diameter so as to remain rigid. This bar is fitted with the cutting tool a little farther than the length of the cylinder from the dead center end by boring a hole through it and filing it out so that it will admit the cutting tool. The tool should be at least one inch wide and preferably five-eighths or three-quarters of an inch in thickness. This tool may be held in place by fixing a setscrew at right angles to the tool through the bar.

In the boring operation the lathe should run at slow speed and the cylinder on the slide rest fed to the cutting tool in the usual manner. But under no circumstances should the lathe be stopped until the tool has cut the full length of the cylinder. If it is, you are sure to have a little bump, or a depression. In reboring a cylinder it is always best to take two light cuts—one through and the other back with the same tool, the rear end of the cutting edge of which is slightly relieved so that when coming back for the second cut it will leave a smooth surface.

[This is a second answer to the problem published in the SCIENTIFIC AMERICAN of May 9th. The other answer was published in the issue of June 24th.—ED.]

A Simple Vise

By B. Francis Dashiell

THE accompanying engraving shows a very handy and easily made vise or clamp. *At A* is a piece of dressed hardwood 12 inches by 2 inches by 1 inch. It is screwed upon the bench or table top. Another piece *B* of the same dimensions is screwed on about



Vise for a bench top.

8 inches away and at an angle of 30 degrees to *A*. A triangular piece *C* with its hypotenuse about 15 inches long is used as a wedge.

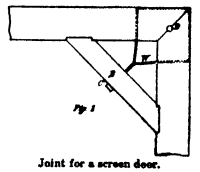
The stock that is to be worked is placed up against the piece *A*, and the wedge *C* is driven up tightly, thus clamping the stock firmly.

Some Oddities in Joints

By W. D. Graves

VISITING a friend, the writer's attention was engaged by a number of jointures which, while they would hardly appeal to the operator of a fully equipped wood-working plant, are all thoroughly practical—however odd—and might well be used by any one lacking the equipment necessary for the expeditious making of more conventional ones.

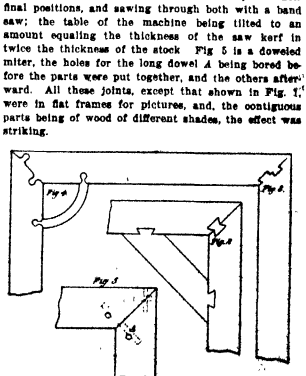
That shown in Fig. 1 was in a screen door corner, and was very secure. The stock was mitered, a wire *W* carried around the corner, through holes as shown by the dotted lines, and the ends passed through a hole in the brace *B*, through a washer *C*, and secured



Joint for a screen door.

in a common nut by pouring the hole full of solder. Turning the nut twisted the wire and drew the joint tight. The pin, or dowel, *D* served to keep the parts from sliding out of place while the wire was being tightened.

Figs. 2 and 3 are self-explanatory, being merely adaptations of the miter and dovetail combined. Fig. 4 is a joint on essentially the same principle but was made by tacking adjoining pieces together, one on top of the other, but otherwise relatively in their final positions, and sawing through both with a band saw; the table of the machine being tilted to an amount equaling the thickness of the saw kerf in twice the thickness of the stock. Fig. 5 is a doweled miter, the holes for the long dowel *A* being bored before the parts were put together, and the others afterward. All these joints, except that shown in Fig. 1, were in flat frames for pictures, and, the contiguous parts being of wood of different shades, the effect was striking.



Joints for picture frames.

The Inventor's Department

Simple Patent Law; Patent Office News; Inventions New and Interesting

Principal Examiner John I. Brown

PRINCIPAL Examiner John Ingalls Brown is the "spring-wheel" man of the Patent Office, the division 41 is in his charge, including spring wheels in the class of resilient tires and wheels which, with railway draft appliances, make up the division 41, in Mr Brown's charge since it was organized



Principal Examiner John I. Brown.

some years ago. While Mr. Brown is essentially a Maine man, he was born in Philadelphia, returning with his parents from that city to their former home in Maine when a child and continuing to reside in Bangor, where he attended the public schools

After teaching school and studying law, in 1884 he was appointed an assistant examiner in the Patent Office He has served in two examining divisions and for some years in the classification division prior to his appointment as principal examiner and the institution of division 41 of which he has had charge for some years

Raised as he was on the Maine coast, Mr Brown has never lost his love of sailing Sailing, however, is not Mr Brown's only hobby, for he is very much of a "joiner" being a member of the Sons of the American Revolution of the Knights of Pythias and of the Odd Fellows To the latter he has devoted much attention, is a member of every branch of Odd Fellowship and one of the most distinguished members of that order, being known wherever the order has found its way throughout the United States He is a grand representative to the Sovereign Grand Lodge I O O F. District of Columbia, and was the Grand Master in 1898

Mr Brown is a member of the bar of the Supreme Court of the District of Columbia, and is now and has been for many years, president of the Beneficial Association of the Interior Department, which Association comprehends the various bureaus of the said department.

The class of resilient tires and wheels is a very active one at the present time because of the great interest in spring wheels and the like as substitutes for cushion tires in automobiles, while resilient tires including cushion tires and pneumatic tires will likely be active as long as automobiles and similar vehicles are used.

A Mechanical Willow Stripper

THE mechanical basket willow stripper with an automatic adjustment to compensate for the variation in thickness of rods has at last been made. The basket willow industry is practically the last of the agricultural crops in which labor-saving machines have been introduced For over a hundred years willow growers have been looking for a machine that would successfully remove the bark of commercial willow rods used for making baskets and other articles Five years ago Mr. George S Herrick, a machinist of Syracuse, New York, undertook the task of designing a machine that would do the work Mr Herrick had already invented several other labor-saving devices, and after learning what an enormous amount of work was required to take rod after rod and remove the bark by hand, which is at best a very tiring and monotonous task, it occurred to him to make a mechanical willow stripper It was a year before he had a machine to try out, and in 1907 he made his first experiment with one which he patented and which proved very encouraging to him and the willow growers around Syracuse At the end of every season Mr Herrick had another machine to try out and each time with a little more practical experience he finally succeeded in making one that does the work On May 31st of last year he patented his mechanical stripper, which is in every way a labor-saving device, and will not only save farmers tens of thousands of dollars every year but will greatly stimulate the industry both in this country and abroad The primary object of this mechanical willow stripper is to supersede hand labor, and with the advent of this machine comes an increased and multiplied opportunity for making basket willow growing very profitable, which under our extensive methods of management, is almost impossible without a machine that will remove the bark at a comparatively small cost The average laborer by the old method of peeling can remove the bark from 75 to 125 pounds of willow rods in a day If the rods are all of an average size Assuming a laborer's wages to be $1.50 per day, the cost of peeling will be about 1½ cents per pound The willow stripper, on the other hand, will peel as much in an hour as one man can peel in a day

When willows are peeled after the sap is up in the spring there are only from thirty to forty days in which to do the work In order to peel all the rods from ten acres the grower is obliged to hire a small army of men, women, and children The required labor is often very difficult to find The mechanical stripper will do the work of ten men and will save the farmer's money and temper, for it will strip his willows more cheaply than if done by hand It is estimated that hand peeling costs about $35 per acre The machine can do this work in just one-tenth of the time and will cost between $3 and $4 per acre It is safe to estimate that the farmer will save approximately $30 on each acre Mr Herrick stripped steamed willow rods right along through January, February, and March, and averaged 125 pounds of rods an hour, which is all that one man can handle in operating the machine Mr Herrick is now designing an automatic feeder, by means of which the daily output will be greatly increased Of course the amount that can be stripped in a day will vary greatly under different conditions and with rods of different sizes and varieties The superiority of this machine over the ordinary brake can hardly be overestimated The brake (Fig 1) is a simple device consisting of a round steel rod from ½ to ⅝ of an inch in diameter and about 4 feet long which is doubled over so that the two ends are brought together, making a double rod 2 feet long The lower or welded end of the parallel rods must be inserted in a log placed at a convenient height The brake must be perpendicular and have the upper ends of the prongs slightly curved out one inch from the top so that the rods can easily be put in the brake. The operator places the thick end of the rod between the prongs of the brake and draws it toward him and the bark is at once separated from the wood The small end is then treated in a similar way, which completes the peeling Figure 2 shows the method of operating the brake

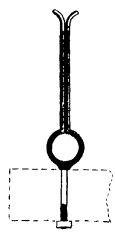


Fig. 1.—The old type of hand-brake.

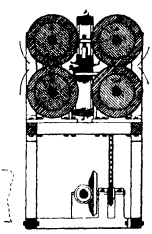


Fig. 5.—Cross-section of the new willow stripper along line x-x of Fig. 4.

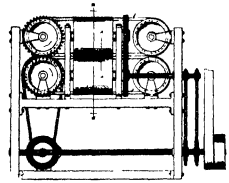


Fig. 4.—Longitudinal section of the new willow stripper.

The mechanical willow stripper is

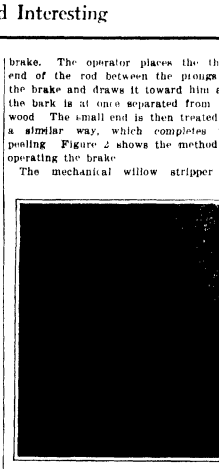


Fig. 3. The mechanical willow stripper.

illustrated in Fig 3 The operator inserts the butt ends of from 2 to 6 rods at a time between two rapidly revolving rubber-faced rollers which are slightly furrowed and which form a suitable feeding device. These rollers which are in pinching contact, are disposed to receive the willow rods transversely and to crack and split the bark throughout their entire length

After the butt ends of the rods have passed through the first pair of rollers (Fig 5, *r*) they pass between two parallel horizontal rubber belts (Fig 5, *bb* at *a*) disposed to receive the willow rods transversely between them These belts, which are known as stripping-members, move in a direction at right angles to the rods passing between the first pair of rollers and are designed to strip the bark from the rods These belts are driven at a comparatively slow speed, while the receiving or feeding rollers are operated at a relatively high speed The faces of these two horizontal belts are in close contact and have their contacting faces correspondingly beveled so that the rods may readily pass between them (Fig 5, *a*) The rods are pushed between these two horizontal belts by the feeding rollers and are then received on the opposite side by the second set of rubber-faced rollers of similar size and are operated at a speed equal to that of the first set of rollers The second pair of rollers are designed for drawing the stripped rods from the belts as is seen in Fig 3

Every part of the machinery is carefully adjusted, but like all other machinery the willow stripper is not perfect It will doubtless be continually improved Having undergone, however, nearly five years of trial and improvement before it was offered to the public it is much further advanced than a good many other labor-saving machines when they are first placed on the market The machine itself, though simple in the extreme, is about as inspiring to the willow grower as the reaper was to the wheat grower It removes the bark from small and large rods by the same turn of the wheels and does not seem to discriminate between the branched and unbranched ones (Fig 6)

The full extent of what the willow peeler will achieve for the grower still



Fig. 2.—The old method—stripping with the hand-brake.

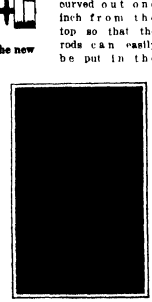


Fig. 6.—Rods stripped by the machine.

remain to be seen, but it will at least make him independent of an army of shiftless and itinerant laborers required every spring for peeling willows. It will make willow growing a scientific industry like that of the other minor farm crops. It means a new era in the basket willow industry.

How I Invented the Air Brake—IV*

By George Westinghouse

BEING fully impressed with the idea that if the wave of air which was utilized for signaling could be made to operate the triple valves upon the cars, there would then be an almost instantaneous application of the brakes upon the front, rear and other portions of the train, this idea, with hard work and a large number of experiments, shortly produced what is now known as the quick action automatic brake. The Westinghouse train was left at Burlington in order that the new triple valves with the quick action attachment could be applied and further experiments made. The valves as developed for this emergency proved to be successful, and the tests made with this train after their application were eminently satisfactory to the railway officials. It was thereupon arranged to take this train to Minneapolis and St. Paul, Milwaukee, Chicago, St. Louis, Cincinnati, New York, Albany, through to Boston and New England, to Washington, and then to Pittsburg, numerous demonstrations being made during this journey of some thousands of miles. This train, drawn by two locomotives, was frequently run at speeds above 50 miles an hour, and the tests were witnessed by all of the prominent railroad people of the country. So great was the demand for good brakes on freight trains that considerable difficulty was at first experienced in promptly filling the orders of railway companies. Nevertheless, the wide publicity given to these tests, coupled with a public demand for the adoption of means to prevent accidents, brought about the enactment of a law by the Congress obliging the railways to apply brakes and also automatic couplers to all freight trains in the United States within a time named in the act, which time was subsequently extended because it was physically impossible for the railway companies to make the introduction within the time first prescribed. The quick action automatic brake was operated like the first automatic brake for ordinary train movements; the quick action resulted only when it was necessary to apply the brakes for an emergency.

No sooner had the quick action automatic brake been developed to operate successfully on trains of fifty cars than new conditions were presented. Steel freight cars carrying enormous loads had in the meantime been developed and freight locomotives had been increased in capacity, so that trains were often composed of seventy to eighty cars, and more recently some trains have had as high as one hundred cars. This possibility had, however, been foreseen, and experiments were constantly being carried on to so improve the apparatus that it could be used to control trains of any practical length, and these experiments also had in view the more nearly instantaneous action of the brakes for ordinary service purposes than was possible with the automatic brake or with the quick action brake. The result was a most important development.

The present improved triple valve has the emergency feature, but it also has what is known as the quick-service application feature, that is, for ordinary purposes, the air is admitted to all of the brake cylinders so quickly that the longest freight train can be handled with almost the precision obtainable in the control of passenger trains of from six to twelve cars.

In the matter of the development of the brakes for operation upon passenger trains, nothing that skill and perseverance could suggest has been omitted in securing the highest degree of perfection. The requirements during the past few years, by reason of the greater weight of cars and locomotives and of the higher speeds at which they are run, have necessitated the redesigning of all the passenger train brake apparatus, including the method of attaching the brake shoes to the cars and the levers and connections for bringing these shoes to bear with the required pressure upon the wheels. For the purpose of insuring the highest efficiency, every wheel of a passenger train, including those under the locomotive, is now acted upon, whereas formerly many of the master mechanics and engineers were apprehensive that it would not be possible to make use of all of the wheels of a locomotive for braking purposes.

During the past twelve months, most elaborate tests of the latest form of apparatus for passenger service have been carried out under the direction of officials of several railways and of the Westinghouse Air Brake Company, in order to prove the operativeness of the new constructions and their capability to insure the highest degree of efficiency.

From the very beginning of its operations, the brake company has maintained a strong staff of experienced engineers, some of whom are located in each of the large railway centers and whose services are always at the command of the railways. It is the duty of one or more of these trained men to proceed to the scene of any accident that may have occurred in order to ascertain the cause, to report thereon, and to render such aid and co-operation to the railway officials as will tend to avoid a like accident if in any manner the brake can contribute to that end.

The air brake company has always had in its works, for experimental purposes, sets of brake cylinders, pipes and couplings, representing the apparatus upon trains of various lengths, so that tests and demonstrations could be readily made for all sorts of purposes, including educating or informing railway officials who came to seek information. To more effectively spread this information, the company, about fifteen years ago, constructed and equipped a special instruction car in which were arranged fifty sets of brake cylinders and pipes equivalent to like apparatus upon a freight train. This car was provided with a boiler to drive the air-pump for the production of the air under pressure needed to operate the brakes. Operative models of all parts of the apparatus were shown in section, so that their construction and operation could be more quickly comprehended. This car, in charge of experienced instructors, was moved from place to place, and engineers, firemen, conductors and other train employees in general visited it to familiarize themselves not only with the operation of the brake, but with its construction, and in this manner there has been developed throughout the country a knowledge of the air brake art which has proved of inestimable value to the railway corporations and their patrons. The records of the Westinghouse Air Brake Company show that to December 1st, 1910, their instruction car traveled over 113,000 miles. Numerous railways have also provided their own instruction cars, so that it may be safely said that every railway employee having anything to do with the operation of trains, freight or passenger, has been required to familiarize himself with the working of the brakes and to so study the subject that he could pass an examination, 280,258 employees having so far been examined by representatives of the Westinghouse Air Brake Company, and in numerous cases these men have been required to show sufficient knowledge of the brake to entitle them to receive certificates of their proficiency.

The importance of the maintenance of the brake to railways has not been overlooked by railway officials. They have appointed superintendents of brakes and numerous inspectors, and to-day there is an association of air brake officials organized in 1893, and now having 1,015 members, who meet annually in convention to thoroughly discuss the questions which are constantly arising, so that at present there exists an organization of which scarcely any of the public has ever heard—an organization which is constantly devoting skill and energy to the care of apparatus which above everything else in connection with railways contributes to the safe transportation of passengers and freight.

I have often been asked how many lives have been saved by the use of the air brake, and I have as often said it might well be a great many thousand, but that it was impossible to make even an approximate estimate. At a banquet given in Washington to the members of the International Railway Congress, in May, 1905, a diplomat, in speaking on the subject of the importance of railway brakes, said he felt safe in saying the air brake had saved more lives than any general had ever lost in a great battle.

I have spoken of four chief developments. It has been necessary, in order to avoid disastrous consequences, that each development should be of such a kind that cars fitted with newer apparatus could operate with little inconvenience with cars fitted with earlier apparatus. As it stands to-day, scarcely any of the old type of brake and the first type of automatic air brake are in use, but should a car fitted with the first form of automatic brake be found and put into a train with the more modern apparatus, such older apparatus would be found to operate fairly well with the more perfect form. The prevailing idea in the development and introduction of the brake has therefore been an adherence to such uniformity of apparatus that the interchange of traffic over various roads could go on uninterruptedly.

There is probably no apparatus now in use which has received such thoughtful consideration and been the object of such care in every one of its details as what is now popularly known as the air brake, and which is in universal use in the United States and in many other countries of the world.

In my estimation, there could be no better illustration of the value of the maintenance of standards than has been given by the manufacture and introduction of air brakes upon railways, for without such standards, train brakes would not have come into general use, with consequences which railway officials and the public can well appreciate.

My story would be incomplete without a reference to the powerful assistance which the railways of this and many other countries have rendered. They have been lavish in providing those facilities for making the thousands of tests which were necessary to progress in the developments I have recited; to the Pennsylvania Railroad especially, upon which the most important experiments were first made, the other railways of the country, as well as the traveling public, owe a debt of gratitude. When a railway (as did the Southern Pacific two years ago) provides a new train of one hundred steel cars to be fitted with the newer form of automatic brake, in order to carry on, with a staff of skilled men under the direction of the chief officers of the company, a series of experiments upon its heaviest gradients, requiring several weeks, for the purpose of securing greater safety and an increased carrying capacity per train, with the consequent lessening of the cost of transportation, it is just that the managers of such a corporation should receive credit for their far-sighted policy. To name the railways and to merely state chronologically the tests of brakes which have been made during forty years would require several volumes.

* From Presidential Address presented at the Annual meeting of the American Society of Mechanical Engineers.

Notes for Inventors

A Narcotic Cartridge.—Karl Durgemüller of Kretensen, Germany, has been granted a patent, No. 993,028, for a means for temporarily narcotizing animals, in which a cartridge filled with a mixture composed of substances containing cap-sicine in an immediately gasifiable form and of easily inflammable substances to accelerate the gasification, is combined with a small quantity of an explosive agent between the mixture and an explosive cap with which the cartridge is provided.

A Curious Anticipation.—An old practitioner before the Patent Office tells of filing an application for patent for a Texas inventor for an improvement in the cutlery class. The invention was unique and examination of the previous patents in the same class failed to develop anything to limit the novelty of the invention in any degree. Much to the attorney's surprise, in acting on the application for patent, the Patent Office Examiner cited, in anticipation of the device, the identical article which the assistant examiner having charge of the application had purchased in Nova Scotia while on vacation many years before, had brought to the United States and had been using on his desk in the Patent Office for more than the statutory period.

Beauty and Invention.—With a woman's appreciation of the importance of anything that aids beauty, Anna Taylor, of Ottawa, Ontario, Canada, has patented, No. 994,619, an artificial eye lash. It is made with a crescent shaped strip of material supplied with adhesive so it can be held in place and short lengths of hair held on the underside of the strip and projecting outwardly from its convex side.

Handling Ships' Cargoes.—The more convenient handling of ship cargoes, is the purpose of the invention of Onofre Lindsay of Valparaiso, Chile, and his patent, No. 994,171, includes a cable way which is fixed at one end and is movably supported at its other end to which is releasably connected a counterpoise. The haul rope, which is endless, engages the counterpoise and also extends around the fixed end of the cable way.

A Swimming Device.—Just in time for the bathing season is a patent to John A. Edwards of Birmingham, Ala. His invention is a swimming device and provides a number of floats to rest on the surface of the water. These floats support an elevated frame work, and hangers drop down from the frame and are connected to the swimmers in the water.

A Pot That Serves Tea or Coffee.—It may be desired to serve several beverages such as tea, coffee and cocoa and Jos. N. Papendry of East Liverpool, Ohio, has patented No. 994,949, a combination pot, which has a number of independent compartments to receive the different beverages. A single spout has openings communicating with their respective compartments and valves control these openings are worked from a point near the handle so the person pouring can open any particular valve and so cause tea, coffee or cocoa to discharge from the spout.

Automobile Accidents and Their Prevention.—Many automobile accidents appear to occur most frequently from breaking or derangement of the steering gear or the bursting or throwing of a tire. It was suggested that in many plants, and machines, duplicate parts were provided which could be quickly brought into use in lieu of broken or otherwise disabled ones, and that possibly this could be done in the case of an automobile parts retained to insure

with the duplicate parts so arranged as to be brought into play, automatically or by the driver, when the original part was disabled. My friend said he thought it would be a good thing, but he did not see how it could be done. Neither did I, or I would do it and reap the reward of a very valuable invention.

An Ingenious Sign.—Much ingenuity and sometimes considerable invention is involved in the production of signs and display cards used by merchants in their show windows. We recently noticed in the window of a paint store a sign made up of a plate of sheet metal on which water was represented. Four slits were made, one near each corner of the plate, and through the upper slits projected the feet and legs of a large doll, while the arms projected outwardly from the rear through the lower slits and appeared to be reaching out for small cans of paint. These cans of paint were placed on sand which had been strewn upon the floor of the window to represent a beach, the whole presenting quite a realistic appearance On the sheet were written the words "Come in," the effect being that of a diver whose arms and legs projected above the surface of the water, but whose body was submerged The sign attracted much attention, and an amusing feature was to notice children, who almost invariably would look behind the sheet to see the rest of the figure. The idea of this sign is obviously capable of many modifications.

German and American Saws.—German carpenters use, instead of hand-saws of the form familiar to every American, those of the buckssw type, only with a narrow blade, which as a rule must be slightly turned out of the plane of the frame, in order to take in boards of a greater width than would be possible otherwise, owing to the middle bar. The result of this position of the blade is a tendency on the part of the frame to turn downward out of the slightly inclined plane in which it lies, so that there is always a strain on the workman's wrist, and often the work is not straight. There is in this style of saw the further disadvantage, that in sawing diagonally across the middle of a piece of work consisting of two boards at right angles to one another, no inclination of blade to frame will enable the piece to be worked I have often asserted this, and recently in my own house was compelled to lend a carpenter who was shortening a bench my American saw—of what the Germans call the "fox tail" pattern. I think that if American saw makers would combine and send a man over there to manipulate the American pattern on work where it can be used and the German buckssw type can not, there would be an opening for good trade.

Why Not a Brazing Machine?—He was a working man with whom the writer got into conversation at the sea shore. The man said he was a coppersmith, and that he had worked in all the navy yards from Maine to California. His talk about his work was full of interest, particularly about the assisting machines and apparatus employed in the various manipulations of copper. It was astonishing to learn that no machine had been produced for use in brazing copper, but that the operation was still carried out entirely by hand No reason is seen why the inventive faculties could not be advantageously employed in solving this problem.

An Ozone Apparatus.—An ozone producing apparatus was patented May 23rd, 1911, to Octave Patin of Paris, France It is made with two concentric glass tubes separated by an annular space, an inner electrode frictionally engaging within the central tube and outer electrode of wire forming a helix and wound in spiral form upon the outer tube and projecting a metallic envelope for the outer tube.

Legal Notes

The Flare-back in Court.—An important patent case, that of John J. Knapp, Trustee, vs. the United States, awaits decision in the Court of Claims, having been argued before that court some weeks ago. The suit is under the general jurisdiction of the Court and not its special jurisdiction of patent matters. The invention forming the subject of the suit seeks to prevent flare-backs in heavy ordnance, and seems to be of much importance to the ordnance branches of the Government, and hundreds of pages of expert testimony, provided on both sides, and extensive illuminating briefs of counsel indicate the importance of the case, which is said in some quarters to involve claims for damages of upward of a million dollars

Iterations in Patents.—The importance of avoiding any alteration in an application for a patent after it is signed and sworn to is emphasized in a decision of Assistant Commissioner Tennant in the case of Ames *vs* Lindstrom, decided October 8th, 1910, in which the Assistant Commissioner, after referring to the alterations made in the application subsequent to its execution and prior to its filing in the Patent Office, says: "The application of Lindstrom is therefore not an application upon which a patent can be granted and cannot be given the effect of a constructive reduction to practice" He further says "As Lindstrom cannot be given the benefit of the filing of his application as constructive reduction to practice, Ames is entitled to an award of priority"

Plaster Works and Their Use.—In holding an optical prism device "of scientific or technical character," pressed to shape in plastic glass, for modifying light rays, not of the class intended to be covered by section 5, sub-paragraph I, of the Copyright Act of March 4th, 1909, Justice Stafford of the Supreme Court of the District of Columbia, in Brock vs National Electrical Supply Company, said "The objects are formed of glass when in a plastic condition by the use of a mold, and so, perhaps, may be considered in a liberal sense 'plastic works,' although, of course, fragile and brittle in their completed state. It is insisted that they are 'of a scientific or technical character,' because they are scientifically or technically produced It is not claimed that they are intended for, or adapted to, special use, in any science or in any branch of technic . . It seems clear to the court that it was the use to be made of the drawings and the plastic works rather than the knowledge or skill required for their production that was referred to in the words, 'scientific or technical' Hence it is believed that the objects exhibited are not of the class intended to be covered by the clause in question, and consequently that the plaintiff's bill is insufficient."

Pure Food and Trademarks.—The Patent Office will not pass favorably on an application for registration of a trademark for a meat product until at least one of the labels filed is stamped by the Bureau of Animal Industries of the Agricultural Department, "Approved, B. A I" The purpose of this is to prevent the registration of any mark for meat products until the products have been approved.

Recent Adjudicated Patents.—Out of seven adjudicated patents reported in the *Patent Office Gazette* of June 6th, 1911, only two were held void in whole or in part. In one of these cases, Anton vs Grier Bros Co (C C. A.) 185 Fed Rep., 796, one claim of the patent was held void as an aggregation of old elements In the other case, that of Heatonville M & F. Pass. Ry. Co. vs. McDuffee (C. C A.), 185 Fed Rep., 798, the patent was held to be void as having been granted on an amended application and claim which was a distinct departure from the original.

RECENTLY PATENTED INVENTIONS.

These columns are open to all patentees The notices are inserted by special arrangement with the inventors Terms on application to the Advertising Department of the SCIENTIFIC AMERICAN

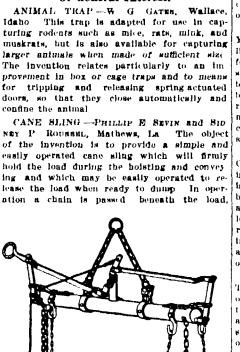
Of Interest to Farmers.

GRAIN WEIGHING SCALE.—A. McLEOD and A T McLEOD, Bloomington, Ill Material is received into a stationary hopper and discharges therefrom into a vertically movable weighing-hopper, so suspended and connected with pivoted weighted beams and other mechanism, that, when a certain load has been received, the weighing-hopper descends a little, whereby a valve controlling discharge from the receiving hopper into the weighing-hopper is closed, and then the gate at the bottom of the weighing-hopper is opened to allow the discharge of the grain or other material therefrom

Of General Interest.

ANIMAL TRAP.—W G GATES, Wallace, Idaho This trap is adapted for use in capturing rodents such as mice, rats, mink, and muskrats, but is also available for capturing *larger animals when made of sufficient size* The invention relates particularly to an improvement in box or cage traps and to means for tripping and releasing spring actuated doors, so that they close automatically and confine the animal

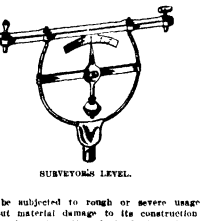
CANE SLING.—PHILLIP E SEVIN and SID NEY P ROUSSEL, Mathews, La The object of the invention is to provide a simple and easily operated cane sling which will firmly hold the load during the hoisting and conveying and which may be easily operated to release the load when ready to dump. In operation a chain is passed beneath the load,



CANE SLING

through the stirrups of a chain which passes above the load and into engagement with the pin When the cord is pulled and the chain slide released the lower chain pulls through the stirrup, releasing the load The embodiment shown in the illustration herewith is especially adapted for heavy loads, since the chains separate beneath the load The complete combination consists of a socket, a pin and a locking pin for preventing detachment of the socket and pin

SURVEYOR'S LEVEL.—WILLIAM M JACOBS, Vale, Ore The level pictured in the engraving presents a side elevation of the complete instrument, which is for use specifically as a simple surveying instrument for determining inclinations, grades, levels, etc It



SURVEYOR'S LEVEL.

may be subjected to rough or severe usage without material damage to its construction It may be easily adjusted should its calibration be disturbed The invention provides adjustments and mechanisms for varying the sensitiveness of the grade indicating mechanism

MEANS FOR RAISING SUNKEN VESSELS.—JAMES SKATSCHKOFF, 1 Degtiarnoiperoulok, St Petersburg, Russia. In carrying out this invention, a case or casing is made of waterproof tarpaulin which is open at the bottom, the case resembling the form of the vessel which is to be raised The case thus consists of a top portion and side walls, which latter extend down far enough to inclose the upper portion of the hull of the vessel

CAGE TRAP.—I RAMIREZ, Matamoras, Mexico This invention relates to cage traps, and while the trap is designed more particularly for rats and mice, the features of construction may be utilized in traps intended more specially for catching other animals alive The chief object is to produce a trap that will be efficient in operation and entirely safe for human manipulation, even by children

CARGO HANDLING APPARATUS.—O LINDSAY, Valparaiso, Chile, S A This device transfers cargoes at sea from one vessel to another by means of a cableway, stretched from the first to the second and upon which suitable carriages having conveying receptacles thereon are arranged to travel, the cableway being connected with means for keeping the same taut, to permit the carriages being easily hauled thereover by hauling means engaging the carriages and extending from one vessel to the other

SUBMARINE BOAT.—G B YERTON, New York, N Y Embodied in this invention is a life-boat for attachment to a submarine craft, for rescuing the crew of the craft should the same sink or become dangerously disabled when beneath the surface of the water The life-boat is for removable attachment to a submarine craft, the boat being secured in such a manner that the boat may be released by the crew or one of the crew, in a very short space of time

SAVINGS BANK.—C A WALKER, Stratford, Conn The invention provides improvements in banks or boxes, whereby the closure cap is conveniently placed in position on the box body and held therein against removal by unauthorized persons, without the use of special locking devices, and whereby the cap can be readily removed for the use of a special implement in the hands of a proper person, to allow of emptying the bank of its coin or other contents

BLIND IRON.—F S HARDEN, Salida, Colo The invention is an improvement in blind irons or stiffeners such as are ordinarily used in the blinds of harness, and has for its object a stiffener which prevents the breaking of the stitches or leather of the blind by rubbing, or other causes, at point of attachment of the winker brace, and the brace from being torn out

Hardware and Tools.

PLIERS.—P G STOMMEN Johnstown, Pa An object of this invention is to provide a pair of pliers which will enable the operator to bend wire or like members into either a curved or straight form, and further permit of the operator exerting a firm but quick increasable hold on fragile, delicate or diminutive articles

SAFETY WINDOW LOCK.—E V AMATO, New York, N Y. The invention provides a plate located upon one sash and carrying pawls, each forming a practically closed loop, provides a locking member having the form of a casing and adapted to be located upon the other sash, and also having means for engaging any one of the pawls, and provides means for holding the pawls in positive engagement with the casing

COMBINED PROTRACTOR AND T SQUARE.—F A DEL CASTILLO, Washington, D C The object here is to provide a combined protractor and T square, for the use of draftsmen, engineers and others and arranged to permit of setting the blades of the square to any desired angle indicated on the protractor or to accurately fasten the blade in right angle position relative to the base of the protractor

Heating and Lighting.

HEATING APPARATUS.—M MÉRAN and M M MÉRAN, 155 Rue du Faubourg Poisonnière, Paris, France This air and gas mixer provides before combustion as perfect and intimate as possible the quantities being supposed suitable, so as to obtain a flame furnishing maximum heat, which latter is increased or reduced by variation of the gas burner Means provide raising to the highest possible temperature a refractory body which will subsequently radiate its heat without detriment to gas combustion The refractory body is of such shape that it can undergo said dem *expansion* without cracking or splitting

Household Utilities.

ELECTRIC IRONING DEVICE.—G A RICKS, La Fayette, Ind This device is adapted to overcome the difficulties common with movable tools, and the object of the inventor is to provide a suitable support for a flexible conductor, and a means for protecting the conductor to keep it off the working surface and away from the tool and to prevent an interference with the working of the tool

AUTOMATIC WEATHER STRIP.—G L GODFREY, Steuben, Maine. This strip is for use on closures such as doors and the like, to prevent moisture or inclement weather from getting into a room through the space ordinarily found between a closure and the casing thereof For this, use is made of a casing provided with means engaging a second casing in con-

motion with a packing, and spring controlled means for automatically raising or lowering the packing when the door is opened or closed

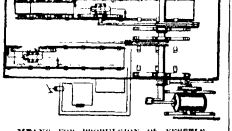
Machines and Mechanical Devices.

METAL STAMPING PRESS.—E H VOGEL, New York, N Y Mr Vogel's invention refers to presses of the kind used for stamping and performing analogous operations, such as punching, shearing, bending and the like, his more particular purpose being to provide a mechanism for increasing the efficiency of the machine, while promoting simplicity of operation and cheapness of operation

SLOYD MAKING MACHINE.—R A GOODE, Andover, Maine Generally speaking, this improvement comprises a feed wheel provided with pockets for picking up skewers one at a time from a hopper, and a dressing which parallels with the feed wheel, but slightly eccentric in relation thereto the purpose of the wheel being to grind off adjacent ends of the skewer blanks while the latter are carried partially around by the feed wheel

COIN CONTROLLED APPARATUS FOR VENDING MACHINES.—O J HOTALING, Johnstown, N Y The device is one which can be used with other vending machines, which serves to prevent the operation of the machine with which it is employed unless the suitable predetermined coins are introduced into the coin slot, which can be adjusted to operate with one or more coins of different kinds, which requires little power to actuate it, which does not modify or affect the operation of the machine, and which is so made that unauthorized or improper operation thereof is accomplished only with difficulty

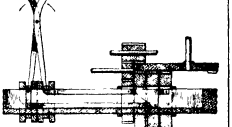
MEANS FOR THE PROPULSION OF VESSELS.—WILLIAM H WHITE, Homewood, Charles St Ave Baltimore, Md The invention illustrated by the engraving relates to means for propelling marine vessels One object is to provide an improved form of slidable plate for carrying the driving pistons An other is to do away with friction caused by the use of inclosing pipes or chutes for the pistons There are several advantages her-



MEANS FOR PROPULSION OF VESSELS

over that form of the device shown in Mr White's prior patent There is no surrounding tube or pipe below the bottom of the vessel in which the pistons move The sliding plate is raised from near the bottom of the vessel The compressed air chamber is disposed so as to cover both slides and a portion of the operating mechanism therefor Air pressure is maintained in the chamber by air pumps Friction is reduced and the slide plates do not fit airtight

POWER TRANSMISSION DEVICE.—ANDREW J SIEBEN, Schawka Neb In this illustrated invention the object is to provide a device in which a direct forward or a reverse movement may be attained by the use of a clutch member carried by the main shaft It provides a device in which forward



POWER TRANSMISSION DEVICE.

and reverse movement may be attained by simple mechanism, thereby eliminating the annoyances occasioned by a multiplicity of parts and reducing cost of manufacture to a minimum It may be used on automobiles or other devices in which a forward and reverse movements are used, and means are provided whereby variable speed movements may be attained

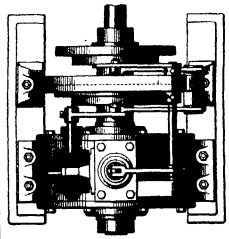
BRICK MACHINE.—A S BACON, Oklahoma Okla The object of the invention is to provide an improved brick machine especially adapted for use in the making of cement brick, which will receive the plastic material and pressed into shape and having means for expeditiously removing the pressed brick onto a pallet for removal from the machine

COMBINED PUMP AND AERATOR.—R W KELLY, deceased, SARAH KELLY, administratrix Atchison Kan *In the present patent* the object of the inventor is the provision of a new and improved combined water pump and aerator, for use on cisterns, wells and various other water supplies and arranged to aerate the water wherever the pump is actuated for lifting or raising water.

PRINTING MACHINE.—W JACKSON, New York, N Y The invention has reference to wall paper printing machines, and its purpose is the provision of certain new and useful improvements in printing machines for printing wall paper borders, whereby the paper after it receives the imprint by the printing rolls is accurately cut lengthwise along the contour of the imprint

Prime Movers and Their Accessories.

ROTARY ENGINE.—WILLIAM J MCMANAMY and JOHN P JOHNSON, care of Thompson and Stout, Whipps Block, Kalispell, Mont A plan view with parts in section is given herewith in the illustration of this invention

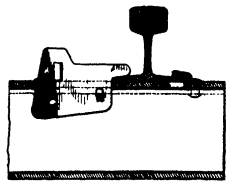


ROTARY ENGINE.

which relates to rotary engines, particularly for steam or other gaseous driving agents, and which has for its object to provide an engine capable of working efficiently in any position, with especial provision of means to prevent or reduce the leakage of steam Two or more cylinders and pistons may be used, combined so that their working periods will alternate or overlap, so as to avoid dead centers The construction of the piston of two separate parts, allows for expansion and contraction The packing rings may be held against the piston by steam

Railways and Their Accessories.

RAIL FASTENING FOR METALLIC RAILWAY TIES.—ALEXANDER BRYDON'S Main St West Easton, Pa Mr Brydon's invention illustrated herewith is an improvement in rail fastenings on which a rail-clamping plate is arranged in a slot in the top of a metal tie arranged adjacent to the rail base supported on the tie The fastening is preferably



RAIL FASTENING FOR METALLIC RAILWAY TIES.

formed as a cotter-pin whose upper edge is inclined to form the wedge proper It may be readily detached by withdrawing a wedge when the plate will drop down into the tie, thus leaving the rail proper free of obstruction on the inner side, so that it may be readily detached from the lugs and removed from the tie

NUT LOCK.—THOMAS F MAY, Lehi, Utah Mr May's invention is an improvement in nuts locked by means of a smaller jam nut The

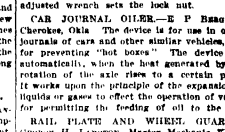


NUT LOCK.

engraving represents a vertical cross section of a railroad rail provided with fish plates secured by a bolt provided with his nut-lock Both nuts being of the same size and form, one wrench of fixed adjustement serves to screw them both home, or to remove both from the nut. Not only does one wrench serve to put on and take off the nut, but it holds the bores of the main and lock nut in alinement, while both are being put on and removed from the bolt, thus preventing the locked nut from turning so as to bring its axial bore out of alinement with that of the bolt nut. The same adjusted wrench sets the lock nut.

CAR JOURNAL OILER.—E P BRADMAN, Cherokee, Okla The device is for use in oiling journals of cars and other similar vehicles, and for preventing "hot boxes" The device oils automatically, when the heat generated by the rotation of the axle rises to a certain point. It works upon the principle of the expansion of liquids or gases to effect the operation of valves for permitting the feeding of oil to the box

RAIL PLATE AND WHEEL GUARD.—GEORGE H LANGTON, Master Mechanic K. C., So Ry., Shreveport La The invention relates to rails for railways and the aim is to provide a guard, for switch points, to guide the wheels of a train safely over the switch point and prevent a derailment For this purpose use is made of a base plate for attach-

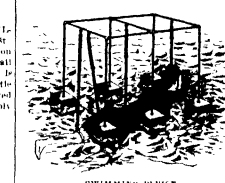


RAIL PLATE AND WHEEL GUARD.

ment to a railway tie and adapted to receive a rail thereon a rail plate on the base plate and extending upwardly and inwardly to engage the rail and wheel guard formed on the base plate and extending toward the rail plate, the guard wheel being spaced from the said rail The plan view shows herewith a switch with the device applied thereto at the switch point end of the switch

Pertaining to Recreation.

SWIMMING DEVICE.—JOHN A EDWARDS, 3701 Avenue F, Birmingham, Ala The device pictured herewith shows the manner in which a swimmer is supported It comprises a plurality of floats a frame-work arranged



SWIMMING DEVICE

upon the floats and supported by them, and adjustable means attached to the frame-work for supporting a swimmer in the water It is inexpensive to manufacture and in supporting a person it is so constructed as to allow the free use of the swimmer's limbs at all times

Pertaining to Vehicles.

RESILIENT WHEEL.—W F MASTERS, New York, N Y The invention has in view a wheel having a tire with roller bearings arranged between the wheel body and the tire, which tend to expand the tire and to keep the latter under tension by a flattening strain, or a tendency of the tire and body of the wheel to rotate relatively Other wheels, such as pulleys, can be constructed in accordance with the invention

WIND SHIELD.—I H SPRAGUE, Norwalk, Ohio In this shield the movement of the upper section is controlled and limited by two distinct separate and connecting means One of these permits the two sections to move as though hinged together or permits them to be held with their adjacent edges spaced apart and in different planes The other serves to lock the two sections in their adjusted position

Designs.

DESIGN FOR A PAPER CUTTER.—D F CALDWELL, New York, N Y This ornamental design for a paper cutter shows an implement of substantial and graceful form, the blade and handle end having the same width through the entire length The scroll work and other ornamentation represent design of excellent artistic quality

MORE.—Copies of any of these patents will be furnished by the SCIENTIFIC AMERICAN for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

NEW BOOKS, ETC.

THE BLUE GOOSE CHASE. A Camera-Hunting Adventure in Louisiana. By Herbert K. Job, State Ornithologist of Connecticut. New York: The Baker & Taylor Company, 1911. 8vo.; 331 pp.; illustrated. Price, $1.25 net, postage 12 cents.

It is not a bad idea to get boys interested in the newer kind of hunting—that is, a hunting with the camera rather than with the gun Taking as his theme the rediscovery of the winter haunt of "the blue goose, the author takes his boy heroes on queer jaunts, across the Louisiana marshes, and through water and fire, imparting by the way an accurate knowledge of Nature and her children of fur and feathers.

ELECTRICIANS' OPERATING AND TESTING MANUAL. By H C. HORSTMANN and V H TOUSLEY. Chicago: Frederick J Drake & Co., 1910. 359 pp.; 16mo.

The first few chapters of this little book give an introductory review of the fundamental definitions and points of general theory Then follows a description of the several types of dynamos and motors, hints for the operation of these machines, chapters on transformers, batteries, lamps, testing, locating dynamo and motor troubles, etc. The print is excellent. The book is bound in a soft leather cover, which adapts it for pocket use.

MOTOR BOATS SIMPLY EXPLAINED. By John Douglas. London: Percival Marshall & Co. 16mo; 98 pp., illustrated.

The first chapter is devoted to hull construction—the "carvel" system, the smooth-skin hull, the clinker build—with drawings and specifications for a simple launch, some brief discussion of the different styles of boats, and a description of the hydroplane The second chapter describes the motor and has some very clear diagrams showing the various types and their operation Fuel, ignition, and driving-gear furnish the subject for other chapters, and hints on the maintenance and running of a pleasure launch follow. The price of this English publication, the Thames rules and regulations are given in an appendix

PLUMBING AND HOUSEHOLD SANITATION. By J Pickering Putnam Garden City, New York Doubleday, Page & Co., 1911 8vo; 718 pp., Illustrated Price, $3.75 net

"Plumbing and Household Sanitation" is on a higher plane than most works of a similar nature Mr Putnam's standing as a member of the leading architectural guilds perhaps accounts for this From cover design to final illustration it is an attractive book to scan, and a close study of the text confirms our first impression of careful preparation and full treatment. The aim is the discovery of the best and simplest methods of insuring a healthy home Types of appliances and methods of construction are presented, and the reader is educated up to the point where he may safely use his own judgment as to the best appliances, of which there are such a multiplicity that merely to catalogue them would exhaust the space at command Many ideas and conclusions are advanced which the writer admits to be not quite orthodox But he believes that it is now possible for one to demonstrate for himself at slight expense whether the contentions put forth in such cases are correct He has done much in the past to introduce advanced methods and to depress the cost of appliances "Simplification" is his slogan Among other things he advocates the omission of the main house trap, and puts forward practical means for otherwise simplifying the systems generally in use

PENROSE'S PICTORIAL ANNUAL. Edited by William Gamble 1910-1911 Vol. 16. London: Percy Lund, Humphries & Co., Ltd 8vo, 192 pp

There is a period in the development of the child when he becomes ashamed to be seen with a "picture book" Later he finds that the love of pictures is not a thing to conceal, but a thing to enjoy openly with the rest of the world, young and old. Certainly no one need be ashamed to be seen with the Pictorial Annual, even though his only object be childish, unalloyed pleasure in the beautiful reproductions it places before his eyes But the work has a further purpose than merely to give pleasure and excite admiration It represents the year's progress in process work Its splendid illustrations are given as examples of the perfection to which the art has been brought. These examples comprise, besides hundreds of smaller engravings, more than one hundred and seventy full page plates in from one to ten colors. Such reproductions as that of Constable's "The Valley Farm" are strikingly beautiful and effective. The text is a worthy accompaniment to the gallery of art, and deals with the difficulties and achievements of a fascinating craft in a thoroughly practical manner "The Decadence of Aquatint and Stipple in England" is the subject of an article by Charles Harrop. Edmund G. Gress gives us "An American View of Typography." And there are articles on two-tone processes, filigree three-color reproductions, photographically-designed advertisements and illustrations, and on other subjects embracing a great variety of means and methods.

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PATENT FOR SALE.—No. 982,76. All purposes. Spool Derrick and Excavating Machine. Patented June 28, 1910. Factory men wanted this. Also contract patented. Three combinations for light manufacturing. Nothing like it. Address, Chas. Cooper, Inventor, Joliet, Ill.

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George Ellery Hale

(Continued from page 28.)

displacements of the lines of various elements; discovery of magnetism in the sun by the photography of vortices and the detection of the Zeeman effect in the spectrum of regions around sun spots; investigation of the flash spectrum of the chromosphere, hitherto observed only for a second or two during a total eclipse of the sun; study of the general circulation of the solar calcium vapor and the local movements near sun spots, and a general investigation of sun-spot spectra, including wave lengths and origin of sun-spot lines, cause of weakened and strengthened lines, etc. These items will be sufficient to indicate the general nature of the work that is being done under Prof Hale's direction at the present time.

In addition to his observatory achievements, Prof Hale has rendered valuable service to science in two other ways, first, by the founding of the *Astrophysical Journal*, the leading publication in its field, secondly, by organizing the International Union for Co-operation in Solar Research This union held its first meeting in St Louis at the time of the World's Fair in 1904 Subsequent meetings have been held in Oxford, England, in 1905, Meudon, France, in 1907, and on Mount Wilson, California, in 1910 At the last meeting there were 84 delegates representing 12 different countries—a splendid tribute to Prof Hale, the founder and always the prime mover in the union

The value of Prof. Hale's work reckoned in dollars and cents would not be rated very high in Wall Street But considered from a higher standpoint, as a contribution to human knowledge it must be accorded a most prominent place in the science of the day The sun is a star It is by far the nearest star to the earth, and can be most easily studied Any addition to human knowledge in regard to the sun is a contribution toward the interpretation of the stars in general and of the universe as a whole.

This point of view has been brought out in Prof Hale's book, "The Study of Stellar Evolution" Prof Hale has been a very prolific writer, but this is the only popular work that he has published in book form For over twenty years he has been a contributor to the leading technical journals of astro-physics and astronomy

Sailing the Seas in a "Cockleshell"

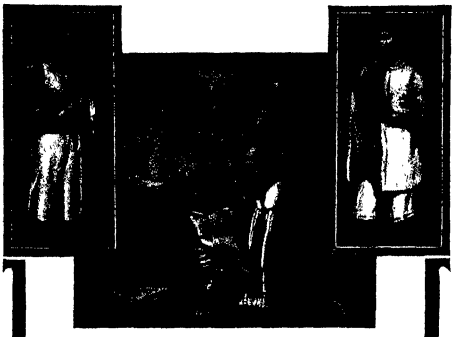
(Continued from page 36)

was for a run of 2,200 miles to the Azores, 900 miles from the Azores to Gibraltar, and another 900 miles to Rome via the Straits of Bonafacio

Not many days after the "Seabird" had set sail to the eastward there came into New York Harbor another little yawl, the "Pandora," which has just accomplished, on a much larger scale, the ocean-sailing feat now being attempted by the "Seabird" The "Pandora" is much bigger than the "Seabird," having, indeed, a length on deck of thirty seven feet, nine inches, and measuring some nine tons

The "Pandora" was built in Australia for two experienced navigators, Captain George Blythe, of Coventry, England, and Captain Peter Arakakis, a Greek She was constructed for the express purpose of making a voyage entirely around the world, sailing to the eastward The trip was made partly for experiment, but more in search of adventure On May 3rd of last year, she set sail from the port of Bunbury, West Australia, and she has just completed her trip across the South Pacific and around Cape Horn to this port. She is not unlike the North Sea fishing boats; and her beam of fourteen feet gives her at once good stability and abundance of accommodations for her owner and skipper.

The craft set sail from Bunbury on May 3rd of last year and coasted to Melbourne, which was reached on May 29th. On July 10th, following, the coasting trip was continued, the next port of call being Sydney, which was reached August 16th; and the following day the little craft was headed eastward for New Zealand this being, of course, the real start of the deep-sea voyage. The run to Auckland is described by the Captain



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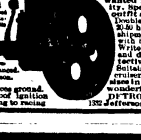
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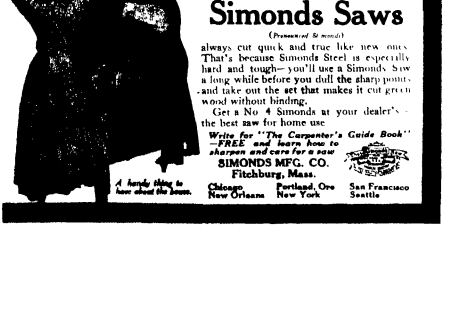


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as being the worst of the entire voyage. On August 28th the wind rose to the strength of a gale and then to a hurricane. The boat was stripped to bare poles, and even at that, shipped a heavy green sea, which swept her full length, and flooded her cabin. Part of the bulwarks was carried away. Finding that the craft could not run safely before a big following sea, she was hove to with a sea anchor. The sea anchor parted and a further section of the bulwarks was torn away, but with the aid of a trysail on the main mast the "Pandora" rode out the gale and reached Auckland, New Zealand, September 4th. There she remained for repairs until October 2nd, when she left for the Pitcairn Islands, which lie 2,750 miles east of New Zealand. On November 21st she passed the Pitcairn Islands and reached Easter Island on December 12th. After a brief stay the "Pandora" started for the Falkland Islands and made her stormy run around Cape Horn, which she passed on January 16th.

On January 22nd, during a fierce hurricane, the vessel was driving under bare poles and lashed wheel, when a heavy sea fell upon the vessel, turned her bottom up and finally, as the masts went by the board, brought her around again to an even keel, the little craft having been turned through a complete circle from left to right. A Norwegian whaler opportunely hove in sight and towed the "Pandora" two miles to the New Islands, where she was laid up for repairs.

She left the Falkland Islands on March 4th, for St. Helena, and sailed thence on April 26th, reaching Ascension Island on May 3rd. On May 7th, she started for New York, which port she reached June 23rd.

After spending six weeks in New York the two captains start for London on their journey via the Mediterranean and the Suez Canal.

Psychological Apparatus for Testing Chauffeurs

(continued from page 89)

the smoked paper. The tuning fork vibrates one hundred times a second, so that each of these indentations marks one-hundredth of a second on the smoked paper. The slightest movement of the wheel, clutch, throttle, or brake in response to the signal flashed by the electric bulb, completes an electric circuit and drops the corresponding pointer on the revolving drum where it begins tracing a line on the smoked paper. And the number of vibrations of the tuning fork before wheel, clutch, throttle, or brake is in operation shows the hundredths of a second that have elapsed between the sight of the signal and the response of the mechanism—in other words the reaction of that pasticular chauffeur under that particular emergency.

With the three colors and the three apertures in the screen in front of the motorist, candidates for the privilege of driving motor cars in public places could be tested for the promptness and efficiency with which they would do the right thing under practically every possible emergency. Mr. Ricker has suggested the following table of signals:

White light in left opening—turn to right.

White light in right opening—turn to left.

White light in centre opening—slow down.

Three white lights—turn or slow down quickly according to position.

The white lights, it will be seen, represent conditions of ordinary travel. The green lights—which bring into play both foot clutch and steering wheel—are more serious, ranging from a released clutch and a turn to right or left according to the position of a single green light to a released clutch and a sudden swerve when three lights become visible. The red lights, finally, call for the emergency break as well as the released clutch and a quick manipulation of the steering apparatus—and three red lights at once might be fairly translated into "imminent death" and make a corresponding demand upon the reactions of the automobilist.

Suppose, for example, that the candidate has mounted into the dummy motor, has had the meaning of the various lights explained to him, and has been allowed to practice with them until the unfamiliarity of his position has worn off and his attitude is normal. Then the real test begins. A white light suddenly appears in the centre of the screen. It means "slow down" and the candidate reaches for the lever and makes the necessary movement, the time being caught and recorded on the smoked paper of the revolving cylinder. Then come three white lights in the centre, which again mean "slow down" but mean also, "be quick about it or somebody may get hurt!" The candidate again handles his lever, but this time the record on the smoked paper should show that he did it very much quicker than in the first instance. And so through various other combinations—with somewhere among them the sudden flashing of the three red signals and the record showing how many fractions of a second were needed for each saving movement at a moment when a difference of a few fractions of a second might in a real automobile be all the difference between a living motorist and a dead one.

Naturally the man whose nervous system is not actually up to the demands that may at any moment be made upon it in motoring would find it difficult to get permission to run a motor, but the average citizen would hardly feel that the weeding out of motorists fundamentally incapable of meeting the more serious emergencies would be a public misfortune.

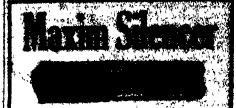
[The reading of this article suggests the following comment. The chauffeurs reaction to a given signal comprises two separate and distinct steps, namely, first, interpreting the signal, and, secondly, responding to the particular emergency which such interpretation implies. What is measured is the sum of these two steps. This sum does not necessarily stand in any simple relation to the time required for the second step alone, and it is this and this only which is of interest in actual practice, where the danger signal is not some peculiar combination of lights, but a perfectly plain and unmistakable situation of real life. Probably the reading of a complicated set of signals would take longer than the response to it, even if the person under examination had been allowed previous practise. These considerations raise some doubt as to the value of the test proposed.—Ed.]

Railway Building in Asiatic Russia: Paris-Peking in Nine and a Half Days.

At the present time Russia has railway communication with her Pacific seaboard only through Manchuria. If you consult maps of Asiatic Russia published during the past eight or nine years you will find the route of a proposed railway indicated along the Amur River from Khabarovsk to Stryetensk on the Shilka (an upper tributary of the Amur); i. e. entirely within Russian territory. According to the *Revue Générale des Sciences* a credit has been voted for the completion of this railway. Another great project about to be undertaken will give St. Petersburg direct railway communication with the Trans-Siberian *via* Viatka, Perm, and Ekaterinburg, to Kurgan, in place of the present route *via* Moscow. Most important of all, it is proposed to build a railway from the termination of the present Chinese line, which extends from Peking to Kalgan, across the Gobi Desert, along the route of the old Chinese post road, *via* Sair-usu and Urga, to Kiakta, south of Lake Baikal. This would enable travelers to journey from Paris to Peking in nine and a half days!

Water Tunnel Beneath Manhattan Island.—The water supply tunnel which is to run at a depth of several hundred feet below Manhattan Island for distributing the water which will be brought down from the Catskills by the aqueduct, will be built for $19,864,627, which, in view of the fact that the estimated cost was $25,000,000, must be considered very satisfactory.

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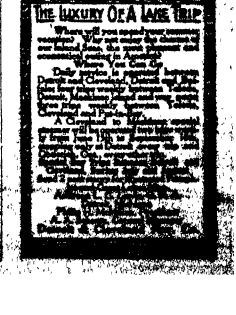
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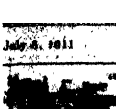
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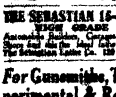
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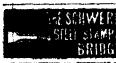
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Aeronautics

Progress of the Paris-London-Paris Aeroplane Circuit Race.—After several days of bad weather, which delayed the start of the fourth stage of the race from Utrecht (Holland) to Brussels (Belgium), twelve of the fourteen aviators that arrived in Utrecht started for Brussels on June 26th. The distance of this stage was 93¾ miles, and the total distance to Brussels 455¾ miles. Even after waiting two days the aviators were obliged to fly in a violent wind and heavy rain showers. Lieut Conneau was the first to reach Brussels. He alighted in his Blériot at 5:30 P. M., and was followed soon after by Vedrines on his Morane monoplane. The latter was presented with a laurel wreath with the inscription, "To the Victor of the Paris-Madrid Race." In all seven aviators arrived up to 9 P. M., Renaux, with his passenger, being the last, with a total time in flight for the 455¾ miles of 39 hours and 49 minutes. Lieut Conneau's time was 37 hours, 27 minutes, and the times of the other aviators were as follows: Kimmerling, 37 34; Vedrines, 38 01; Garros, 38 23; Gibert, 38 56; Duval, 39 07, and Wynmalen and Vidart, who arrived the next morning, 52 46-32 and 60 52 52.

Delivering Mail by Aeroplane.—Upon the departure of the huge "Olympic" on her first eastern trip from New York on June 28th, Aviator Tom Sopwith attempted to drop a message on board the steamer when she was passing through the Narrows. Accompanied by Richard R. Sinclair, he left the aviation field at the Nassau Boulevard at 3 27 P. M. He flew over Brooklyn and circled above New York Bay. At length, when 1,000 feet in the air, he discovered the "Olympic" just as she reached the Narrows. He made for the liner post haste, and flew down to within 200 feet of her before dropping the package. This missed the deck by a few feet and was lost in the bay. Nevertheless the possibilities of the aeroplane for delivering mail were demonstrated in a practical way. As the speed of an aeroplane can be regulated so that it is no faster than the speed of a giant liner, it is possible for the aeroplane to come up astern of the liner and hover above her while mail and packages are not only dropped aboard the steamer, but while they are also hoisted up to the aeroplane to be brought ashore.

Accidents in the Fourth Stage and Results of the Fifth Stage of the European Circuit Race.—On account of the extremely bad weather conditions, several aviators came to grief in the fourth stage of the above-mentioned race. M. Tabuteau fell and wrecked his Bristol biplane at Glize, a short distance from the Belgian frontier. Vidart (Deperdussin monoplanes) and Prevost and Train were also stalled at the same place. Train completed the race the next day, as did also Wynmalen whose H. Farman biplane was stalled 35 miles from Brussels. Le Lasseur's Blériot fell near Breda, slightly injuring the aviator. Barra arrived at Brussels the evening of the 27th. His M. Farman biplane landed heavily, but he was not injured. Emile Train arrived the same evening. He was the last one to finish this stage. The winner of the race to this point received a cash prize of $8,000, and also $3,000 additional for winning the fourth stage. The fifth stage of the race a distance of 56¼ miles from Brussels to Roubaix (France), was flown by ten of the competitors on Wednesday, the 28th ultimo. Vedrines was the first in this stage of the race. He arrived at 11 04 A. M., having covered the distance in 58 minutes 46 seconds (57.4 miles per hour). His fast flight won him the biggest part of the $3,000 prize given by the Roubaix Exposition for the fastest time. Garros arrived second at 11·17 A. M., his time for the 56¼ miles being 1¼ hours. He was followed by the remaining aviators in the order named: Kimmerling (time, 1:11). Conneau (1:24), Vidart (1:58), Renaux (1 54), Gibert (2·06), Valentine (1 37), Train (4:09), Prevost (4:43). Wynmalen and Barra postponed their flight until the next day on account of the heavy winds. Duval fell before he reached the frontier. His Caudron biplane was wrecked, but he was not seriously injured.

Electricity

Explosion in a Nitrogen Plant.—According to a press report the nitrogen works at Trostberg, Bavaria, were recently destroyed by an explosion. At this plant, in which American capital was invested, nitrogen was recovered from the atmosphere by the electric arc.

Wireless Telegraph Station.—The German Postal and Telegraph Department is taking measures to erect wireless telegraph stations on the Baltic at Swinemund and Konigsberg, and another will be installed on the North Sea on the Sylt Island. It will be remembered that wireless plants are already in operation at Heligoland, Cuxhaven and Norddeich. This latter station, which ranks among the principal wireless plants of the Continent, is soon to be enlarged.

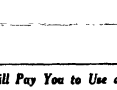
Telephones in Fire Alarm Boxes.—Fire alarm boxes fitted with loud-speaking telephones are now installed in the suburban district of Kiel, Germany, and they are placed at various points along the streets. This appears to be the first time in which loud-speaking telephones have been applied to fire alarm use. The telephones are mounted in an iron box, and upon opening the cover an electric contact is made which rings up the nearest Fire Department station. Owing to the use of such telephones the voice is always heard clearly, in spite of the street noises.

Lighting the Turin Exposition.—For lighting the grounds at the Turin Exposition, there is to be used a very neat method. As the grounds extend along the sides of the river for some distance, it was decided to use 130 arc lamps, which will all be connected in series, so that the current coming from the city mains at 6,300 volts can be used directly for the whole system. For a given number of lamps it is a well-known fact that the size of the wiring is cut down as we raise the voltage. For instance, if all the present arc lamps had been connected in series of four upon a low voltage of 220 volts, 29 tons of copper would be needed for the wire. By using 130 lamps in series only two tons of copper are required. The new German Conta lamp is used.

New Lamp Filament.—A new metallic filament for incandescent lamps is made by the Regina firm, and it is having some success in Germany. Tungsten is combined with carbon by a process invented by Hopfelt. First a tungsten filament is made and this is covered with a layer of carbon by suitable means. This is said to give a very hard and elastic filament for lamps, and it runs on a small current. Some 32 candle-power lamps of this kind were put through a test at the Cologne municipal electric plant, and were found to burn for 2,000 hours and over in some cases. They take 1·04 watts per candle-power when new, and 1·13 after 2,000 hours' run. When the lamps are placed horizontally the life is less, or 1,500 hours. The new lamps are made in sizes up to 600 candle-power. Some of them have the new Euphos glass bulb, which is of a slight yellowish green hue, and absorbs the ultra violet rays, so that the light is safer for the eyes. The present lamps are made to run on 100 volts.

Re-chargeable Dry Batteries.—A new electric dry battery is now being introduced in London, according to the *Electrical Review and Western Electrician*, which is claimed to have a useful life up to three and one-half years, and as the deterioration when it is not in use is negligible it will retain its charge for several years. It may be re-charged several times in the same way as a storage battery. For the negative element a number of zinc plates are employed and for the positive element a carbon rod is imbedded in a composition formed of charcoal and manganese oxide, surrounded by a mixture of ammonium chloride, chloride of lime, and zinc chloride. These elements are placed in an electrolyte consisting of amylon, obtained from the sago palm, with exciting salts composed of platinum-ammonium chloride and zinc-ammonium chloride. This electrolyte, which is in the form of a jelly, is claimed to retain its moisture for long periods and to be but little affected by variations of temperature.

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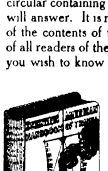
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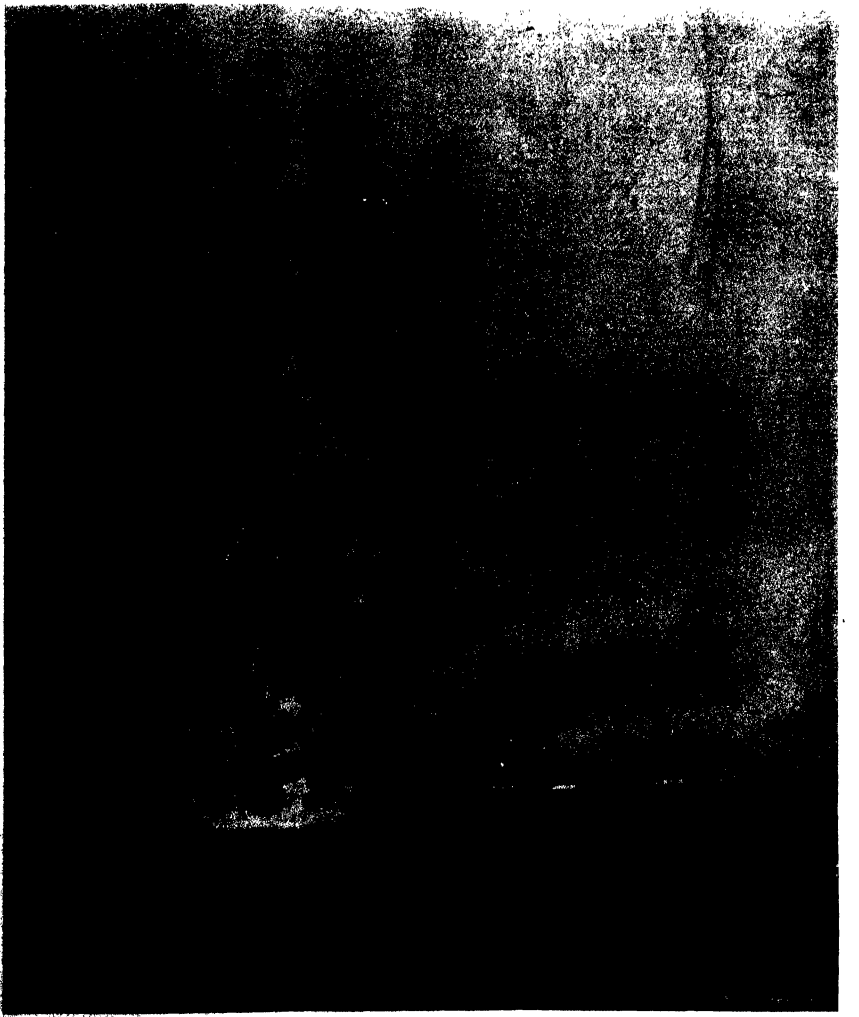
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The purpose of this journal is to record accurately and in simple terms, the world's progress in scientific knowledge and industrial achievement. It seeks to present this information in a form so readable and readily understood, as to set forth and emphasize the inherent charm and fascination of science.

Montauk as an Atlantic Terminus

DURING the past few months, much has been published in the daily press about the proposal to build at Montauk, on the eastern end of Long Island, a large terminal harbor for the use of trans-Atlantic passenger steamers. The avowed object of doing this is to shorten the Atlantic passage and save two or three hours of time. The distance from Montauk to New York by rail is about 120 miles, and it is proposed that the steamships enter the new harbor and transfer their passengers to special railway trains, which in two or three hours time would land them at the new Pennsylvania station in the heart of Manhattan Island, thus saving a few hours over the steamship route.

It is probable that the recent propaganda is the joint work of the railroad company which controls the Long Island Railway system and certain of the steamship companies which are seeking permission of the government to lengthen the North River piers to accommodate the great length of their latest vessels. As far as the steamship companies are concerned, it is no doubt their belief that if the business interests of New York could be brought to believe that the construction of a Montauk terminus was being seriously undertaken, they would unite in an application for longer piers, so earnest and unanimous, that the desired government permission would be granted.

Now, although the SCIENTIFIC AMERICAN is an earnest advocate of pier extension, we do not believe that favorable action on the part of the federal government will be brought about, or even assisted, by such a palpable "bluff" as this talk about transferring the trans-Atlantic terminal from this city to a remote spot on the sparsely settled coast of the eastern end of Long Island. For the astute men of the engineer corps of the United States army are too well versed in those fundamental principles which govern the selection of terminal ports to be deceived by the arguments set forth. It is in accordance with those principles that New York is to day the leading port for trans-Atlantic passenger travel and, if reasonable enterprise is shown in providing adequate facilities, New York must ever remain the leading port.

Furthermore, if the geographical and other demands which have given New York its predominance were ignored, and a port were formed at Montauk, it is very doubtful if all the wealth and influence of the railroads and steamship companies combined could divert travel from the present to the proposed harbor.

No one doubts that it would be possible to build at Montauk a magnificent and ideal terminal for Atlantic steamships. It is easy of access; provides ample depth of water for the largest vessels, and in the matter of piers, purviews, railway facilities, and all the et cetera of a point of transfer from ocean to railway, it could be made the most perfect work of its kind. But when the harbor was completed, it is very doubtful if the traveling public would appreciate the supposed advantages thus provided.

The fastest of our modern liners, the "Mauretania," has crossed the Atlantic at an average speed of 26 knots, or over 30 miles an hour, and at this speed she would cover the 120 miles to New York in four hours' time. If, instead of proceeding to New York, she entered Montauk Harbor, and transferred her passengers to special trains, they would take at least two and a half hours to make the run to Manhattan. It is true that some hours would be consumed by the "Mauretania" at quarantine, and in steaming up the harbor to her pier in the North River; but there would be a similar delay at Montauk for quarantine and in warping the big ship to her berth for the discharge of the passengers. The ultimate gain in time would be possibly an hour and certainly not over two hours; and as an offset against this would be the inconvenience to the passengers of an extra transfer—that from the steamer to the train—an objection so serious that it would probably prove a source of very material loss in passengers to any steamship line that made use of Montauk as a terminal.

In the earlier days of ocean travel, when accommodations were cramped, and the ships were small and of slow speed, the shortening of the voyage by a few hours would have been a matter of some importance; but in these days of giant vessels, whose bulk is so great that they are steady in any but the heaviest seas, and whose accommodations are such that the traveler is surrounded with all the conveniences which he has come to look upon as essential to his daily comfort, the matter of two or three hours more or less on board ship is one to which he is supremely indifferent. Certainly he would not wish to exchange the spacious dining saloons, lounges and smoking rooms of an ocean liner for the relatively cramped and uncomfortable accommodations of a modern railroad train.

But there are even weightier considerations, largely of a geographical character, which show the futility of the attempt to artificially create a trans-Atlantic terminus, 120 miles distant from the commercial metropolis which it would be intended to serve. The selection of the site for the great ports of the world has not been determined either by caprice or accident. The existence of the magnificent New York Harbor at the point where that great natural line of travel from the west to the Atlantic seaboard by way of the Great Lakes, the Mohawk Valley, and the Hudson River, reaches the Atlantic coast, determined beyond any chance of later reversion where the principal meeting point of rail and ocean traffic would be found. The phenomenal growth of New York in population, trade and wealth was rendered inevitable by its splendid strategic position. The hundreds of miles of foreshore, the vast wharf and other terminal facilities (inadequate and capable of much improvement though they may be), the existence here of the terminals of the great railroad systems, the concentration here of the thousand and one trades and industries that cater to the ocean steamship, and finally the fact that within a few minutes of the landing wharfs are to be found the finest hotels in the country, and theatres and places of amusement by the score,—all these considerations, in addition to those of the inconvenience of transfer above mentioned, conspire to render the position of New York as the point of departure and arrival of Atlantic steamships forever permanent and unassailable.

Artificially Induced Mutations

IN the course of his work in elaboration of his theory of evolution through mutation, DeVries made the suggestion that alterations in the hereditary properties of organisms are due to changes in the germ plasm occurring before fertilization. In order to test the possibility of localizing such supposed changes, Dr. D. T. MacDougal (director of the Department of Botanical Research of the Carnegie Institution of Washington) started some far-reaching experiments about six years ago. Some of his general results have been referred to from time to time, but there has not until now been a complete account of what was done. This now appears in the *Botanical Gazette*.

A number of workers have attempted to obtain a modification of the developing embryo by placing the cut ends of flower stalks in various solutions, or by applying various solutions to the growing plant, but all results were negative. MacDougal adopted the plan of injecting the solutions into the ovaries of the plants just before fertilization was to take place. He used in his earlier experiments specimens of *Raimannia odorata* and *Oenothera biennis* which had been cultivated for several generations in pure cultures, where they showed no more differences than the ordinary fluctuating variations. The solutions used were various strengths of sugar, zinc sulphate and calcium nitrate in distilled water. The solutions were introduced into the ovaries by means of an ordinary hypodermic syringe. The first result of the operation was the casting off of the developing ovary in most cases. But some of the seed ripened in both species.

All the seedlings of the derived *Raimannia*, although ovaries from the three different treatments were represented, presented the same appearance—and that was different from the parental type. This evening primrose is a biennial: the derived individuals all ripened their seed during the first season. This involves not only the physiological character of whatever is concerned in early flowering, but the growth habit of the plant was entirely different from that of the parent. The *Raimannia* produces rosettes of leaves during the first year, the stem remaining very short; during the second season the stem elongates very rapidly, bearing leaves and flowers. Another difference between the original type and the induced derivative is perhaps even more striking. All the plants of this family regularly bear hairs on the skin of the leaves and stem. In the derived individuals the skin was quite free from hairs.

The results with the *Oenothera* were equally definite and were distinguishable from the very first. The cotyledons of the new plant are broader and of a brighter green than those of the original and the same is true of the leaves of the rosette. The plants have been cultivated for five generations and retain their new characters without any indication of a tendency to revert to the parent type. Specimens have been grown in different localities together with the parent form, and the differences remain constant.

The derivative of *Oenothera biennis* was hybridized with the parent form and resulted in a plant bearing intermediate characters, but being more vigorous in growth than either parent. The indications are that the derived *Oenothera* is a distinct type related to the parent but not intergrading with it.

Since 1906 over twenty species of plants chiefly desert forms, were experimented with. Although the fatalities among the experimental plants were high, owing to the action of ground squirrels, birds and other enemies, as well as to the results of the operations, a number of seeds were saved and grown. In a species of *Pentstemon* native to Arizona there appeared to be induced a new type as a result of the treatment of the ovarics, but whether the characters displayed by the derived individuals are really new to the species cannot be known with certainty since it has been impossible so far to obtain a pedigreed culture under control conditions.

The question of how the introduced solutions modify the reproductive cells cannot of course be answered by these experiments. In order to throw some light on this question, flowers of the giant cactus were used, with solutions containing methyl blue, and other flowers, with other pigments. On examining the flowers on the day after the injection of the dye, it was found that the solution had been absorbed in varying degrees by the different tissues of the ovary and ovules; but in no case had the pigment penetrated to the embryo-sacs. In the flower of the cactus the distribution of the methyl blue was such that the pollen tubes growing down into the ovary were affected. It would appear therefore that whatever effect may be produced by the solutions introduced into the ovaries is upon the pollen element rather than upon the embryo-sac nucleus. But the real nature of the changes produced is still unknown. It is impossible to observe the direct action of the reagents used upon the cell elements; this may be chemical, or it may be physical.

There are at present under observation seedlings from treated ovaries of about a dozen species of plants. While it is not yet possible to induce a desired mutation at will, these experiments will no doubt lead to results that will be of lasting practical as well as theoretical value.

Substitute for Platinum

IT has been suggested that, in the prevailing scarcity of platinum, the metal palladium might be a practicable substitute. It belongs to the platinum group, and has many of the qualities of platinum, although in some respects it resembles silver. Among its valuable characteristics are hardness, ductility and malleability. It is also decidedly non-corrodible. It occurs, along with nickel, copper, silver, gold, platinum, iridium and rhodium, in the ores of the Canadian nickel mines in Ontario. Out of 800,000 tons of these ores about 5,000 ounces of palladium are annually produced.

The Upbuilding of Our Merchant Marine

Our Extensive Foreign Trade and the Near Completion of the Panama Canal Call for Immediate Action

By the Hon. Charles Nagel, Secretary of the Department of Commerce and Labor

THE subject of the merchant marine has been discussed so exhaustively that the sole remaining question seems to be one of ways and means No one doubts that our merchant marine should in some manner be restored. Our coast line is so extensive, and the success of its marine service is so great, that the suggestion for an ocean marine is constantly kept before us. The marine service upon the lakes and along our coast emphasizes the absence of an ocean marine and strengthens the demand for legislative aid to foreign trade across the oceans.

This situation is accentuated by the fact that the Panama Canal is nearing completion. As it appears now, all the countries that control a merchant marine will be in a position at once to make use of this new maritime route. Our country, however, has taken no steps to the same end, but on the contrary our strength is dissipated in discussions about ways and means by which the merchant marine might be restored It looks to me that this delay may have serious consequences We not only lose the immediate opportunity and profit; but routes once established and connections made by foreign trade are not easily dislodged If our country wants to get the full benefit of this newly-created opportunity, with all it implies, we should be prepared at the inception to take full advantage of this route, established by our enterprise and with our money

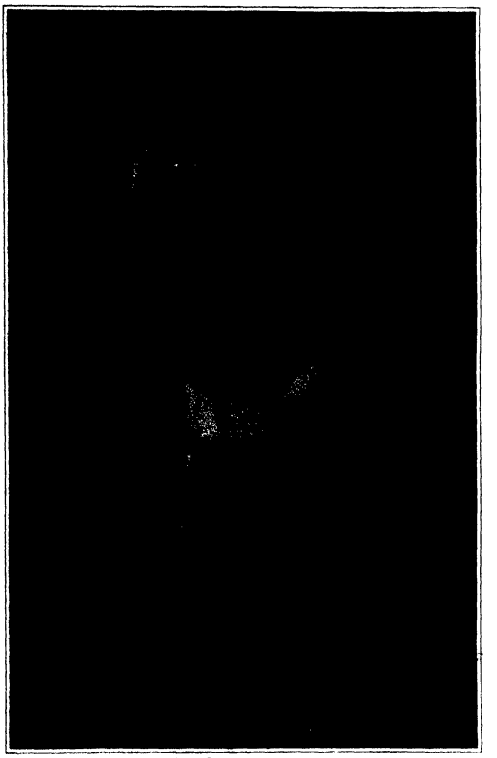
The country which is first upon the ground with its goods has an undoubted advantage; and the country that sends its goods in its own bottoms at once gives the highest possible guaranty of its determination to maintain its trade In my judgment, one of the great advantages, if not the greatest, in having our own merchant marine, rests right at this point It is not only a question of profitable investment, and of the employment of money and men; but it is a question whether we shall give foreign countries with whom we propose to establish and maintain trade a guaranty of our good faith and continued purpose Neither government nor business is determined by material interests alone Impressions and sentiment are not to be disregarded. Foreign countries with whom we seek to establish intimate commercial relations will not be convinced of the earnestness of our purpose, until our country is prepared to have its consignments come into foreign harbors under our flag, to be delivered from our decks Such a pledge of our determination to sustain lasting relations would be accepted above all others.

Again, it is often said that foreign ships plying between our ports and foreign ports provide ample facilities for all our foreign commerce Superficially speaking, that may be true. There may be ships enough to accommodate all the trade between all the countries in question. But granting this to be true, in my judgment the real situation is not met These foreign ships sustain no commercial or administrative relation to our country. They do sustain, as a rule, the closest possible relation to the countries in which they are owned. I am not now speaking of the financial support, be it subsidy or something else, but I am speaking of the power which foreign countries exercise by way of making rates for purposes of successful competition on their part. It goes without saying that our commercial competitors everywhere sustain a much closer relation to their governments than probably would be possible under our political institutions. In foreign countries commerce has the immediate encouragement of government, participates in deliberations which go to the development of that commerce, and finds encouragement by way of protection of one kind or another The same thing is true of the carriers Rates are made to meet the demands of the situation, and it goes without saying that we do not enjoy exceptional rates when we undertake to compete with the commerce of those countries in which the ocean carriers are owned and controlled We have adopted a policy of equal rates for all shippers, and that rule is now pretty fairly enforced. We are therefore compelling our trade, under a regulation of this kind to compete with the commerce of foreign countries in which the same rule is not enforced It appears to me to stand to reason that we are therefore not in a position to compete upon equal terms We are compelled to depend upon carriers who are beyond our control, but who are free to respond to the demands of foreign trade when it is in competition with us

The situation is difficult enough with respect to our commercial organizations, upon whom we depend to introduce our trade into foreign countries We do not tolerate combinations in this country, whereas like organizations engaged in competition with us in foreign countries are systematically sustained. This, of course, is an unavoidable condition—a price we pay for the delayed reconstruction of our commercial forces. But it appears to me that such a condition should not be carried to an unnecessary length We depend upon a foreign merchant marine, which may, and no doubt does, give preference to our competitors We are confronted with the question of whether or not we can successfully complain even of a combination or a monopoly between all the foreign ocean carriers that enjoy the trade of our ports It appears to me, therefore, to be high time to consider ways and means by which we may restore our own merchant marine, to serve us impartially in competition, and to respond to such regulations as our country through our Government may see fit to impose upon such an agency

Of course I am aware that there are many other reasons that may be assigned for the restoration of a merchant marine It is apparent that a navy such as we have ought to be supplemented by a merchant marine, and that without such aid in case of need the navy is necessarily in a measure handicapped I prefer, however, to rest the case in favor of a merchant marine solely upon the commercial considerations which to my mind are conclusive

As to the means by which such a result is to be accomplished, I prefer to say nothing I think the issue has frequently been confused by the cry of subsidy, and by the contention that other countries do not subsidize, and that, therefore, we ought to be able to restore our marine without such assistance I think the facts show that in one way or another, most, if not all, countries which have a considerable merchant marine do give support Be that as it may, we are dealing with a condition and not with a theory We know that the enterprise of our country has challenged competition in nearly every field We know that we are making progress in the extension of our foreign trade We know that our lake and coastwise marine service is at least equal to that of any other country We must conclude that the absence of an ocean marine must have some reason other than accident or a lack of initiative If we are to compete successfully with foreign countries we must gage the instrumentalities which they employ And if we are unwilling to resort to their methods, then it must at least be for us to ascertain what we can and must do to engage in successful competition We cannot afford to rest upon our oars The day has passed when we can expect things to come to us because we have vast resources and great natural wealth The time has come when we must fight for our position in the field of commerce, and when we must take into account the means employed by others in determining what it is for us to do



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HON. CHARLES NAGEL

Secretary of the Department of Commerce and Labor.

Measurements of Subterranean Temperature

THE deepest hole in the world, up to date is the boring begun ten years ago at Czuchow Silesia with the object of attaining a depth of 2,500 meters and which has now reached a depth of 2,240 meters (7,349 feet) The bore is 44 centimeters in diameter at the top, and diminishes progressively to 5 centimeters Measurements of temperature have been made regularly At 2,220 meters the temperature is 83.4 deg. C (182 deg. F) This gives a "geothermic degree" (amount of descent corresponding to a rise of temperature of 1 deg C.) of 31.8 meters The change of temperature does not proceed uniformly In fact an interesting "temperature inversion" occurs between the depths of 640 and 730 meters, where the temperature actually falls, with descent, about 2 deg.

The American Merchant Marine

Analysis of the Causes Underlying the Amazing Growth and Rapid Decline of American Shipping

By the Hon. Eugene Tyler Chamberlain, Commissioner of the Bureau of Navigation

THE total tonnage of documented American shipping to-day in round numbers 7,500,000 gross tons—is second only to the British total of 19,000,000 gross tons On the Great Lakes alone we have 2,100 steamers of 2,500,000 tons, which in efficiency are unsurpassed, and in the aggregate are more than double the tonnage of Japan and greater than that of France Indeed, the fleet on our inland seas ranks next in tonnage to the 4,300,000 tons under the German flag, which visit every port in the world In view of these facts, the question may well be asked What signifies dissension in and out of Congress on the decadence of the American merchant marine? The answer is to be found in the fact that barely one-tenth of our tonnage is registered for the foreign trade, and that at the present time less than 500,000 tons are so engaged In oversea competitive navigation we barely hold the eighth place, and the absence of our flag in foreign ports is the subject of pertinent comment by travelers Our ships carry less than nine per cent of our exports and imports While the Congress has divided more or less on party lines over the choice between subsidies or free ships, practically every maritime nation except the United States has both systems and we have neither in effective form

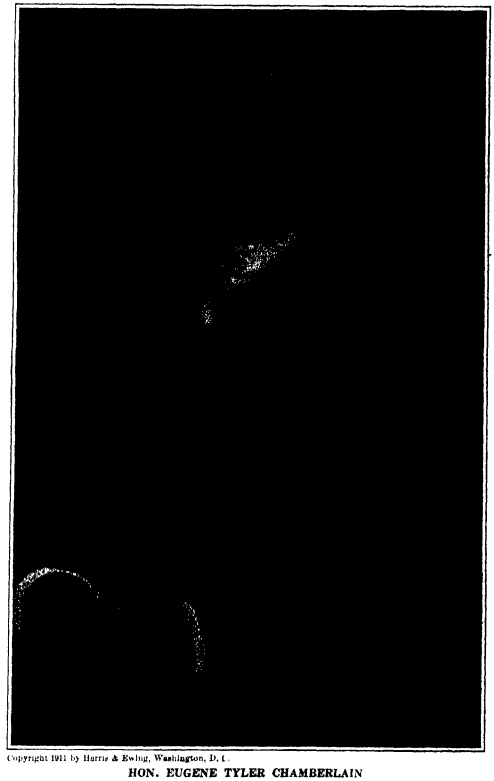
Two generations of men now living saw the time when the United States was pressing Great Britain close for the commercial mastery of the seas The radical changes in our navigation have thus been effected within fifty years, but a cursory glance at simple gross tonnage figures may illustrate crudely the lines of our development in navigation Expressed in thousands of tons (ton equals 100 cubic feet), the following table shows for important periods the tonnage of our merchant shipping, together with its three lines of occupation—the foreign trade, the domestic coasting trade, and the fisheries

American Documented Tonnage.

	Foreign	Domestic	Fisheries	Total
1789	124	68	9	201
1800	667	272	33	972
1820	584	588	108	1,280
1860	2,179	2,645	329	5,353
1870	1,449	2,638	159	4,246
1910	782	6,669	57	7,508

Perhaps no other single thing better illustrates the courage and tenacity of purpose the political and business prescience and the broad humanity which inspired the fathers of the republic than their early and persistent attack upon the system of discriminations in navigation devised by Oliver Cromwell and relentlessly followed by the advisers of the House of Hanover against the Americans whom two wars had failed to subjugate "Those principles of liberal intercourse and of fair reciprocity which intertwine with the exchange of commerce the principles of justice and the feelings of mutual benevolence," as expressed by President J Q Adams in 1828, "were first proclaimed to the world in the first commercial treaty ever concluded by the United States in 1778 with France, and have been invariably the cherished policy of our Union" Our Presidents, from Washington to Taft, have consistently followed that policy, in which all parties have concurred Mr Adams added "whatever of regulation in our laws has ever been adopted unfavorable to the interest of any foreign nation has been essentially defensive and counteracting to similar regulations of theirs operating against us"

Up to 1820 the Federal statistical system was imperfect and inaccurate, so those figures in the table above must be taken with allowances. This period, too, embraces our own war of 1812 and the Napoleonic wars which disturbed commerce and embarrassed navigation During this period 180,000 men were required to man England's navy, while only 140,000 were employed on her merchant fleets England's absorption in war enabled the United States in the first part of the nineteenth century to begin to supplant her as the world's carrier



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HON. EUGENE TYLER CHAMBERLAIN
Commissioner of the Bureau of Navigation.

The period of maritime reciprocity from 1820 to 1860 witnessed the greatest and most rounded development of American merchant shipping. In these forty years in both foreign and domestic trade our tonnage multiplied fourfold—a rate which has been surpassed for a corresponding interval only by the marvelous development of German shipping during our own day, inspired by Bismarck and sagaciously encouraged as a political as well as a commercial policy by the Imperial German Government At the present rate of growth modern Japan perhaps may make even more rapid progress. The growth of those forty years was due to natural causes The races of Northern Europe, with but a slight admixture of the Latin, combined to form the free population of the colonies which became the original States of the Union

Bred to the sea and confined to a narrow seaboard, these men and their descendants found occupation and profit as well as outlet for the spirit of adventure in navigation to all quarters of the globe. Ships were built of wood and our illimitable forests furnished abundant material, while England's depleted timber lands compelled her to import from a distance materials for naval and merchant fleets. The discovery of gold in California opened to our navigation a new trade which was restricted by law to American vessels But even during the period of its most rapid growth causes were at work to check American maritime progress and to promote the growth of British shipping. Of these the most influential was the increasing use of iron as the chief material of construction for ships' hulls. England's supply of iron was abundant, while our own supply was limited, and the advantage which the United States had enjoyed in its forests swung back to Britain and her mines of coal and iron The Fulton Centenary is fresh in the minds of all, and one need barely allude to the fact that from the outset Americans were among the first to apply steam to navigation. Yet the substitution of the steamer for the clipper ship, for reasons inherent to the nature of our people, was as effective in checking our growth as the substitution of iron for wood The nature of work and the kind of men to perform it on shipboard were revolutionized by this change The full-rigged ship demanded of its officers and crew intelligence, skill and daring in the open air, and of its owner enterprise and more or less of the speculative spirit In these Americans excelled The greater part of the work on the steamer consists in shoveling coal deep down in the hold, and for this kind of work the American has no adaptability. Even if the drain of the civil war on the young men of the North had not made it necessary for Congress to repeal the law of many years' standing requiring two-thirds of the crews of American ships to be Americans, it is certain that such a change before 1870 would have been forced upon the statute books. For the steamer, too, England had the coal which we at the time were producing in limited quantities She had the miners to serve as firemen and coal-passers on her steamers, while we were just beginning to dig on the surface of our mineral wealth

The causes named would have sufficed to have put England far to the fore even if the civil war had not turned Americans aside from commercial competition with foreign nations to armed conflict with one another. In the table above between 1860 and 1870 our fleets in foreign trade and the whale fisheries lost 1,000,000 tons—almost the exact measure of American shipping transferred to foreign flags through dread of the "Florida," "Alabama" and the "Shenandoah," or actually captured as prizes or burned at sea by the Confederate privateers

The policy of ocean mail subsidies adopted by England in 1840 and consistently followed since, has always stimulated the building of the highest types of steamships, and while the aim of the policy has been political the indirect benefits to British shipbuilding and navigation have been considerable. If Congress, at the close of the civil war, had passed a bill allowing our citizens to purchase steamers abroad and register them under the American flag for foreign trade, it is quite possible that the losses consequent upon the war would have been partly made up. To overwhelm the Confederacy required an immense number of sailors on our warships of all

descriptions, and these would have readily returned to merchant shipping. Five years, too, had not sufficed to turn our shipowners and shipbuilders from the sea to the land, nor had it destroyed their prestige in foreign ports. That course was not followed; on the contrary, an act was passed denying a return to the flag of any American vessel transferred to aliens "during the existence of the rebellion."

The first trans-continental railroad was completed in 1869 by the junction of the Union and Central Pacific railroads. From 1870 to the present time the railroad mileage of the United States has increased from 53,000 to nearly 350,000 miles. Without heaping up readily accessible figures these and the conclusions to be drawn from them suffice to show that after the war the capital and energies of the country were turned entirely toward internal development. Transportation by land, agriculture, manufactures, and mining absorbed all the capital and labor which formerly had been engaged in oversea shipping and many times more than those amounts. The bulk of our lake tonnage and much of our coastwise shipping is subsidiary to railroad and mining corporations. Even the Norwegian immigrants to the United States, sailors born, do not stop at our seaboard cities, but go west to the farms of Minnesota, the Dakotas, and already are moving thence into Manitoba and the remoter farm lands of Canada. The wealth and prosperity of the country as a whole and of individuals have undoubtedly been greater by this diversion than would have been possible by a persistent effort under adverse conditions to try to meet foreign competition on the ocean.

The table above shows that since 1870 we have virtually ceased to be a maritime commercial power competing with England, Germany, France and Japan, or even lesser commercial powers. Sixteen years ago we had a fleet of the four fastest and finest trans-Atlantic mail steamers, but these have long since been surpassed, and such trans-oceanic steamers as we have to-day owe their existence to the Ocean Mail Act of 1891, or to the anticipated passage of the subsidy bill of twelve years ago, identified with Senator Frye, former Senator Edmunds and the late Senator Hannar.

Vessels built in the United States and no others can engage in our domestic commerce. Foreign competition is cut off by prohibitory penalties. To this statute, dating from the early years of the republic, and to our naval shipbuilding programme, we owe the existence of such seaboard shipyards as we have to-day. On the lakes foreign competition is shut off by Niagara Falls and the limited capacity of the Welland Canal quite as effectually as by legislation Since 1870 our shipping on the Great Lakes has increased from 685,000 tons to 2,890,000 tons, while in forty years our shipping in domestic commerce along the seaboard has increased from 1,950,000 tons to 3,780,000 tons, or scarcely doubled.

The figures of our own maritime growth of course are inconclusive unless we compare them with the growth of other maritime nations during the last century and during the first decade of the twentieth century. A somewhat different method of statistical statement is necessary to present accurately the facts for so long a period. The merchant fleets of 1800 comprised entirely sailing vessels, while those of the present time are made up almost exclusively of steamers. The steamer is a much more efficient carrier than the sailing vessel, for obvious reasons In comparing the two types, the best authorities practically agree that at the present time the net tonnage of the steamer (net tonnage being the space available for cargo and passengers, excluding machinery, bunker coal, etc) should be taken at four times the net tonnage of the sailing ship. The table below, in thousands of tons, gives Mulhall's figures for 1800, and on the basis just stated the potential tonnage of shipping for 1900 and 1910, computed from Lloyd's Register for the years specified

	Potential Tonnage.		
	Mulhall	Lloyd's Register	
	1800	1900	1910
British	1,856	31,917	44,795
American	970	5,420	12,107
German	160	5,868	10,040
French	250	2,468	3,780
Norwegian	70	2,925	4,031
Various	730	12,492	22,056
Total	4,026	62,100	96,809

The ships of England, Germany, France, Norway and most foreign powers sail the salt seas, more than half the American tonnage for 1910 in the table above traversed the improved channels and fresh water of the Great Lakes In ten years the carrying capacity of the Great Lakes fleet has increased more than threefold

In a few years the Panama Canal will probably be open to navigation The trade by sea between the Atlantic and Pacific coasts of the United States is reserved to American vessels If reasonable advantage be taken of our enormous expenditure in constructing the canal, its opening to commerce will result in a rapid increase in American shipping Consistently with our treaties we are at liberty to provide that tolls on American merchant vessels passing through the canal either in domestic or foreign trade shall be paid from the treasury of the United States There are ample precedents for such legislation in acts of Congress and in the legislation of other countries in respect of their navigation through the Suez Canal. It now seems probable that even before the opening of the canal the Congress may pass a law allowing ships built abroad to be registered in the United States exclusively for trade with foreign countries and with the Philippines. Ships have not been built for that purpose in the United States for some years, and the domestic shipbuilding industry would not be materially affected thereby, as of late American capital seeking investment in maritime enterprises has bought ships built abroad and sailed them under foreign flags From such legislation the amount of anticipated benefit has been greatly exaggerated The Gulf of Mexico and the Caribbean Sea are thronged with steamers owned by Americans, but sailing under foreign flags Conditions of political unrest in Central American States, Venezuela, and recently in Mexico, have made it certain that were the opportunity offered, the owners of these fleets would seek American registry in order to secure at all times the protection of the flag In trans-oceanic navigation, however, such considerations do not obtain, and it is difficult to find any satisfactory inducement for the transfer of a foreign-built ship to the American flag in the face of the higher wages which indisputably prevail on American ships

It is a matter for profound regret that the United States has not carried to completion the ocean mail system undertaken twenty years ago The reasons for the establishment of a complete ocean mail system are much stronger now than they were at that time Alaska has been developed, we have acquired Hawaii, the Philippines and lesser Islands on the Pacific and Porto Rico on the Atlantic, and the highest statesmanship both here and in the republics to the south of us has interested itself In bringing about closer relations between the two Americas Sooner or later the establishment of such a system is as inevitable as was the building of our new navy Agitation for more than twenty years was needed to create a fleet of modern battleships, and an equal or longer time may elapse before an adequate ocean mail subsidy bill will be approved by Congress with certain results Of England's mail subsidy system some years ago President Hadley of Yale College wrote

"Its aims are political and not commercial It is a necessity for England to have constant communication with her colonies, and she has spent large sums for this object It is almost equally important for her to have an efficient naval reserve and transport service, and she has made her mail contracts one among several means toward this end"

These words apply with equal force to the necessities of the United States to-day Free ships for foreign trade and subsidies are not alternative or conflicting propositions, but independent methods of dealing with two different subjects

A Remarkable Ice Palace

THE use of ice for architectural purposes is an art that has been carried to a high state of perfection in northern countries, and some almost incredible feats have been accomplished in this curious branch of industry

Probably the most remarkable building constructed wholly of ice was the palace built on the Neva by the Czarina Anne of Russia, in 1739. The first attempt to construct this building was unsuccessful, as the slabs of ice were too thin, and the building collapsed in the first thaw Subsequently large blocks of ice were cut and squared with great care, and laid on one another by skilful masons, who cemented the joints with water, which immediately froze. The building, when completed, was fifty-six feet long, seventeen and a half broad, and twenty-one high. It was of but one story. The façade contained a door surmounted by an ornamental pediment, and six windows, the frames and panes of which were all of ice. An elaborate balustrade, adorned with statues, ran along the top of the façade, and another balustrade surrounded the building at the level of the ground. The side entrances to the inclosure were flanked with pillars supporting urns, the latter containing orange trees, whose branches, leaves and flowers were all of ice. Hollow pyramids of ice, on each side of the building, contained lights by night. The grounds were further adorned with a life-size figure of an elephant, with his mahout on his back. A stream of water was thrown from the elephant's trunk by day, and a flame of naphtha by night.

A tent of ice contained a hot bath, in which persons actually bathed. There were also several cannons and mortars of ice, which were loaded with bullets of ice and iron, and discharged.

The interior of the building was completely furnished, with tables, chairs, statues, looking-glasses, a clock, a complete tea-service, etc., all made of ice, and painted to imitate the real objects. A bed-chamber contained a state bed, with curtains, a dressing table with a mirror, pillows, bed clothes, slippers and night caps—all made of ice. There were ice candles, burning naphtha; and, most wonderful of all, an ice fireplace contained burning ice logs'—i e , blocks of ice smeared with naphtha and then kindled.

Wonders of Telephony

THE casual user of the 'phone who lifts off the receiver and talks to a friend miles away, has little idea of the wonders of telephony or of the labor necessary to maintain an up-to-date service

The "telephone laboratory" is one of the busiest places in the world It is here that the problems of telephony are worked out and means devised to improve and develop the system to meet future demands upon it.

Here any day one may see two experts in a room 15 or 20 feet wide and two or three times that length, talking with each other over circuits a thousand miles long The equivalent of twenty miles of cable is contained in a box no bigger than an ordinary traveling bag, and 600 miles of pole line is represented by the contents of another box not as large as a dress suit case, while the entire apparatus at the central office, so far as it affects the individual subscriber's telephone line, is compressed into a couple of square feet.

With this equipment and two standardized telephone instruments, conversations over hundreds of miles are carried on within the four walls of this laboratory, one of the workshops of the central engineering force of the system

Every detail of a long distance circuit from the subscriber's 'phone at one end of the line to that at the other end, with all the central office and overhead and underground construction that connects them, is reproduced with scientific exactness By these means new devices and apparatus are tested, proposed improvements investigated, and the scientific theories involved in transmission and operation worked out This may be done for the purpose of studying some minor bit of mechanism, of determining, for instance, the relative merits of two forms of the relay coils which automatically work the signals on the switchboard, or of learning the effect on a conversation of having one sort of equipment at one end of the line and another sort at the other end, or for any of a hundred other purposes

Rules for Memorizing the Strength and Density of Concentrated Acids

THE following mnemonic rules, republished from the *Zeit f ang Chemie* have been given by E H Riesenfeld for the relation between percentage composition, specific gravity and concentration expressed in grammes per liter

1 The per cent content of concentrated hydrochloric, nitric and sulphuric acids is equal to their molecular weight, while the concentration in gramme molecules per liter is equal to ten times their specific gravity This is brought out in the following table

Concentration	Baumé, Deg	Mol, Wt	Content, Per Cent.	Sp. Gr	Gm. Mols Per Liter
HCl	23	36	37	1 2	12
HNO_3	40	63	63	1 4	14
H_2SO_4	66	98	98	1 8	18

2 The percentage of aqueous hydrochloric acid is equal to 200 times the difference between its specific gravity and that of water, or in other words $p = 200\ (s - 1)$ This relation is shown in the appended table:

Sp Gr.	Content, Per Cent.	Sp. Gr	Content Per Cent.
1 01	2	1 10	20
1.05	10	1.15	30

The Only Way to Restore the American Merchant Marine

Why Preferential Duties are Better than Free Ships or Subsidies

By the Hon. William Sulzer, Member of Congress

WE all realize that there is a sentiment, growing stronger and stronger every day, throughout the country in favor of doing something to rehabilitate our merchant marine. This is patriotic, eminently proper and should be encouraged by every true American. It is unfortunate, however, that many well-meaning citizens, who desire to see our ocean carrying trade restored to our own merchant marine, have little knowledge of the best way to do it, or of the causes which gradually drove our shipping from the high seas and placed us finally at the bottom of the list of the world's maritime powers.

There is no man in this country more anxious and more willing to enact proper legislation to restore the American merchant marine than myself, but I want to do it honestly, I want to do it along constitutional lines, and I want to do it in harmony with that fundamental principle of equal rights to all and special privileges to none.

It is a fact—a most deplorable fact—and every man who has investigated the subject knows it, that we have less registered tonnage for deep sea carrying trade to-day than we had 100 years ago. In 1810 the United States, with a population of less than 10,000,000 inhabitants owned more registered tonnage for ocean carrying trade than the United States in 1910, with a population of over 90,000,000. The American deep sea tonnage in 1810 was over 1,200,000, and it is now less than 800,000, and what is worse still, it showed an actual decrease of more than 6,000 tons last year. In 1810 American ships, flying the American flag and manned by American sailors, carried over 90 per cent of our deep sea trade and a great part of that of all the countries of Europe. To-day we carry very little of our own trade, and practically none of other countries notwithstanding the fact that we should be the foremost maritime power in the world.

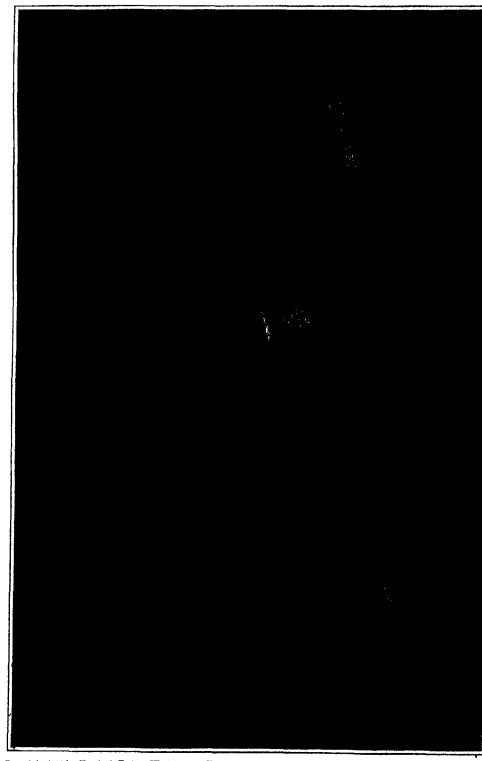
It is a sad commentary on our growth and greatness that more than nine-tenths of our once great and powerful deep-sea fleet has vanished, and not one new keel for an ocean going merchant ship is being laid to-day on either our Atlantic or Pacific coast while the vessels of foreign nations throng our ports and monopolize more than nine-tenths of all our import and export commerce.

The question of the hour is how shall we restore the American merchant marine? What shall we do to place our flag again on every sea? What policy shall we adopt to regain our ocean carrying trade and revive our shipbuilding industry? There are several policies proposed by those who desire to restore the American flag to the high seas and secure for our country its proper share of the world's ocean commerce, and, briefly enumerated they are as follows.

First—Ship subsidies.
Second—Free ships.
Third—Preferential duties.

Let me briefly discuss these proposed remedies in their order, stating as succinctly as I can, without prejudice, the merits and the demerits of each proposition, and I shall do so from a patriotic and not from a political point of view, because, in my judgment, the restoration of our merchant marine is purely an economic question based on patriotism, and rises superior to partisan considerations.

Let us come, then, to the first proposition, to wit, ship subsidies. In the light of the past, I think we can safely say that the American people are unalterably opposed to a ship subsidy raid on the Treasury. A subsidy is a bounty, a bonus, a gratuity, and it never has succeeded, and it never will succeed, in accomplishing the purpose desired. All history proves it conclusively. Wherever and whenever it has been tried it has failed. In my opinion, if a subsidy bill should pass it would not restore our American merchant marine or aid our shipbuilding industries. It is a waste of time to talk about ship subsidies. We might just as well pass a bill to pay a subsidy to every man who grows a bushel of wheat or raises a bale of cotton as to pay a subsidy to the man who builds a ship.



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HON. WILLIAM SULZER
Member of Congress. Author of the bill in Congress for preferential duties.

I am now, always have been, and always expect to be opposed to ship subsidies that rob the many for the benefit of the few. Ship subsidies do not build ships; they create ocean monopolies. Ship subsidies will not give workmen employment in American shipyards; the money taken without justification from the Treasury of the people will simply go to the men who own the ships now in commission.

Every scheme of this kind simply permits respectable corruption and benefits the few at the expense of the many. The principle of ship subsidies is inherently wrong, absolutely indefensible, and no man who understands the question can justify the policy in the face of the facts.

The taxpayers of our country, burdened now almost beyond endurance, are opposed to ship subsidies. They are opposed to any gift bill. They say no private business should be aided by direct grants from the Treasury. Ship subsidies are subversive of the eternal principles of equality, contrary to the theory of our institutions, of doubtful expediency, and at war with the spirit of the Constitution. Congress has no power to subsidize any trade, on land or sea, at the expense of the taxpayers of our country. Any attempt to fasten this odious system of ship subsidies on the legislative policy of the country is undemocratic, unrepublican, and un-American.

And now let us discuss the second remedy, to wit, free ships, by which I mean the right of an American citizen to build or buy a ship anywhere, give it the benefit of the American registry laws, and place upon it the American flag. To bring this about, all that is necessary to do is to repeal the prohibitive law, which is a blot on our common sense and a disgrace to our maritime intelligence; but this will never be done while the believers in protection for the sake of protection can prevent it, because they know it would be a death blow to their sacred doctrine. This policy of free ships has been advocated for years by many able and patriotic men who thoroughly understand this shipping question and deplore the loss we are sustaining every year by reason of the elimination of our merchant marine.

What a spectacle is presented when we realize that by virtue of our existing navigation laws the American who builds or buys a ship in a foreign country is an outlaw—prevented from giving the vessel American registration and compelled to sail the ship under the protection of a foreign flag.

There are, of course, several other objections urged against free ships, but I shall not go into details now and discuss them because I believe it will be impossible to pass a free ship bill at present through the Congress of the United States.

Now let us take up the third proposition, namely, preferential duties in favor of American-built ships and against ships flying the flag of a foreign country. My bill introduced in the congress provides for this, and I hope to see it pass ere this Congress finally adjourns. This was the policy so successfully in operation in this country up to 1828, when, to please foreign interests, the law was suspended, and from that day to this our prestige on the high seas has been declining until it is less to-day than it was a century ago.

The true friends of our merchant marine believe that if this policy of the fathers was restored it would revive our oversea carrying trade, and in a very few years build up our ship industries so that we would again secure our share of the ocean commerce of the world and save millions and millions of dollars that we pay annually to foreign shipowners. In reading the report of the Merchant Marine Commission, I observe that several of the largest shipbuilders testified that they formerly believed in subsidies, but had changed their opinions and now advocated preferential duties.

There seems to be but one objection, so far as I can learn, to a return to preferential duties, and this objection comes from the advocates of ship subsidies, who declare that we have commercial treaties with foreign governments containing the favored-nation clause, and in order to inaugurate the policy of preferential duties it will be necessary to change our commercial treaties, and this cannot be done without giving these favored nations one year's notice.

This objection, however, is more apparent than real, for there is no doubt the change could be made if this Government wanted to make it, and a year's notice to bring it about would cause no great delay, especially when we consider that nothing has been done for our deep sea shipping in more than a quarter of a century.

If we desire to change our commercial treaties with these favored nations, we have a perfect right to do so, and no nation can object. If there be retaliation, two can play at the same game, and our trade is more important to other nations than their trade is to our country. As I have said, many citizens and several distinguished members of Congress who have given this subject much thought and consideration believe that preferential duties will effectually solve the problem in the most feasible and practicable way.

It is my candid opinion, and I have no hesitancy in saying so, that if we had continued the policy of the fathers, and not suspended our early preferential duty laws, we would to-day be the greatest maritime nation in the world, and our flag would be on every sea and our ships would be carrying the commerce not alone of our own country, but perhaps half of that of all the other great nations of the world.

In this Congress I have again introduced my bill for preferential duties. It is a short bill and reads as follows:

A BILL

TO ENCOURAGE THE MERCHANT MARINE AND AMERICAN COMMERCE, AND FOR OTHER PURPOSES

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That a reduction of the duty of five per centum ad valorem of all of the customs duties now or hereafter imposed by law shall be allowed on all goods, wares, and merchandise imported into the United States in vessels of the United States. The said reduction in duty herein provided for shall not apply to goods, wares, and merchandise not of the growth, production, or manufacture of countries contiguous to or bordering upon the territory of the United States when imported into the United States by land transportation or land vehicles or conveyances through or from ports or other places of countries bordering upon the United States, if the same shall have been brought to such ports in vessels not of the United States. And said reduction of duty shall not apply to all cases where goods, wares, or merchandise are transshipped or transferred from a foreign vessel port, or place to a vessel of the United States for the purpose of evading the provisions of this Act.

SEC. 2. That the master, agent, or owner of any registered vessel of the United States shall be exempt from the tax of *four dollars for every alien* entering the United States on such vessel prescribed by section one of the Act of February twentieth, nineteen hundred and seven entitled "An Act to regulate the immigration of aliens into the United States."

SEC. 3. That the President shall have power, and it shall be his duty, to give notice within ten days after the passage of this Act, to all foreign countries with which commercial agreements have been entered into making any provision or provisions which are in conflict with sections one or two of this Act of the intention of the United States to terminate such agreement at a time specified in said notice, which time shall in no case be longer than the period of time specified in such agreements respectively for notice for their termination. *Provided*, That until the expiration of the period when the notice of intention to terminate hereinbefore provided for shall have become effective, or until such date prior thereto as the high contracting parties may by mutual consent select the terms of said comercial agreement shall remain in force.

SEC. 4. That all Acts and parts of Acts in conflict with the provisions of this Act are hereby repealed, and that, except as provided in the first and second sections, hereof, this Act shall take effect and be in force from and after its passage.

To the champions of subsidies, which at best are only a temporary relief, I reply that we never can help our shipbuilding industries and restore our merchant marine unless we adopt the policy of free ships or discriminate in some way in favor of our own ships and against foreign ships. The fact is that we discriminate now by law against our own ships in favor of foreign ships. My plan is simply to reverse the situation. I sincerely believe that if my bill for preferential duties were enacted into law, the United States in a few years would become the mistress of the seas, and American ships built in our own shipyards would do all our own ocean commerce besides a great part of the deep sea carrying trade of the other countries of the world, without taking a dollar out of the pockets of the taxpayers.

Let me say in conclusion, that the policy I propose is not a makeshift. It is not new—having been the law of our country from 1792 to 1828, when it was suspended—and that suspension was one of the greatest political blunders in all our history. It is not a temporary expedient. It is permanent. It has been tried and not found wanting. It is the only way to restore the American merchant marine. Adopted again as our policy and upon the statute books, it will never be repealed, but, on the contrary, speedily restore our ocean carrying trade, revive our shipbuilding industries, give employment in our shipyards to thousands and thousands of men in all parts of the country, bring about an era of prosperity such as we have never known before in our shipping trade and deep sea commerce, place our flag on every sea and in every port, and make our seamen what they were in the historic days of the republic—the pride of America and the masters of the ocean highways of the world.

Smallpox in the United States in 1909

WHILE the sentimentalists are shouting "Anti-vivisection" and "Anti-vaccination" at us, the scientists are "sawing wood." A compilation from the State and city health reports for 1909 pertaining to smallpox has just been published by the Public Health and Marine Hospital Service. Complete reports are available for only twenty-six States and the District of Columbia. In all of these and in most of the other States the disease was prevalent during 1909.

The States showing the largest number of cases (over 1,000), as well as the rate per 100,000 of population, are shown in the following table.

	Number of Cases	Cases per 100,000
Kansas	2,197	131.67
Illinois	2,135	38.31
Utah	1,854	507.11
North Carolina	1,733	79.45
Oklahoma	1,434	90.41
Minnesota	1,430	69.41
Louisiana	1,409	(Incomplete)
Indiana	1,363	50.74
Ohio	1,328	28.14
Wisconsin	1,208	52.14
Michigan	1,175	42.38

After Utah, with the exceptionally high rate of over 507 cases to 100,000, the highest rate was reported for Montana, 187.46 per 100,000 of population; then came Kansas and Oklahoma. The best showing was made by Florida, Connecticut and New Hampshire, which reported, respectively, 3, 3 and 2 cases.

The disease in 1909 was of a comparatively mild type, the death rate averaging less than 1 per cent. This is very low when compared to a mortality of from 18 to 28 per cent, which was the record in European outbreaks in recent years.

The importance of vaccination was again demonstrated by the outbreak of the disease in Yorkville, S. C., during March and April, 1909. The first case was that of a man of 32 years, unvaccinated, who died within two weeks. Fifteen persons had been exposed to infection from this case, of these only two had been vaccinated, one five years previously and the other forty-four years. These two nursed the patient for ten days, and neither contracted the disease. Of the other thirteen, eight died. Vaccination had been applied as soon as vaccine could be obtained; it was effective in five cases. And these were the cases that recovered. In the meanwhile all the other inhabitants of the town were vaccinated—about 400 in all; and although the thirteen persons who had contracted the disease from the first patient furnished seven centers for further infection, an epidemic was entirely prevented, only one other case developing, and that of a mild type.

The compilation, prepared by Assistant Surgeon-General John W. Trask, includes two maps of the United States, one showing the number of cases in each State and the other the rate per 100,000 for each State.

The Gem Production of the United States

THE total value of the precious stones produced in the United States in 1909 was $534,380, an increase of $118,317 over 1908. The increase is due, according to a press bulletin of the United States Geological Survey, to larger outputs of turquoise, tourmaline, variscite, chrysoprase, californite and kunzite. The production of beryl, garnet, peridot and topaz showed a decrease in value. The output of turquoise matrix and turquoise amounted to over 17 tons, that of variscite to over 3½ tons, and that of tourmaline to over 2½ tons. A beautiful new gem, benitoite, resembling the sapphire in some respects, has been found in San Benito County, Cal. Californite is compact, massive vesuvianite and resembles jade in hardness, texture and color, and should be a popular native gem. Chrysoprase has also been mined in California.

Deposits of turquoise have been worked in Arizona, California, Colorado, Nevada, New Mexico and Texas. Turquoise is generally found in arid or desert regions, where mining is difficult. New Mexico, California and Arizona were formerly the chief sources of turquoise, but during the last few years Nevada has been one of the principal producers. Variscite, like turquoise, is generally found in desert regions. The output formerly came from Utah under the names of utahlite, chlor-utahlite, amatrice and variscite, but since 1908 a number of deposits found in Nevada have contributed to the production. Recently there has been an increased demand for this gem in the matrix.—*The Engineering and Mining Journal*.

A Forest Service Circular on Colombian Mahogany

THE forester, the lumber dealer, and the wood user have long been painfully conscious of the prevalent tendency on the part of wholesalers to substitute one wood for another of better grade and quality. Even the importer of foreign woods will be surprised to learn from authoritative statements that more than 50 per cent of the bulk of the woods now shipped into this country as mahogany is not mahogany at all, but in the majority of cases such substitutes are much inferior woods. In a circular entitled "Colombian Mahogany, Its Use as a Substitute for True Mahogany," just issued by the Forest Service, Mr. George B. Sudworth, Dendrologist, and his assistant, Mr. C. D. Mell, call attention to the fact that fully 20 entirely different woods are now being sold as mahogany. They inform the readers that the Colombian mahogany (*Carapa guyanensis*, Miers), a wood from Colombia, has been sold in this country and abroad for more than thirty years as the genuine mahogany (*Swietenia mahagoni*, Jacq.). The circular is written with the greatest regard for scientific accuracy and thoroughness but in such a way as to interest the average intelligent reader. It contains excellent information for the wood user, but it embodies much interesting reading for the botanist as well. The first part of the publication gives the botanical characters of the tree yielding the Colombian mahogany and compares them with those of true mahogany. To the botanical description is added a general consideration of the source of supply, quality, chemical and physical properties of the wood, and its uses. The circular describes very fully for purposes of identification by the unscientific reader the woods of these two species, treating with special fullness the minute structural characters of the wood of the Colombian mahogany. The rest of the circular is devoted to a clear presentation of the difference in structural characters between Colombian and true mahogany. In these days of substitution of lumber, this circular has a good claim to popular favor among mahogany consumers and buyers of furniture. It is a valuable contribution to the scientific knowledge of economic woods and the material should be useful to readers unfamiliar with the subject. The circular is profusely illustrated with numerous excellent black line drawings prepared by one of the best trained artists in the country.

The Shame of Eating

IN some primitive tribes, eating is regarded as something to be ashamed of. Karl von der Steinen, the celebrated explorer, was looked upon as a very ill-bred person by the natives of South American forests because he ate in the presence of others. The original ground of the shame associated with eating is a fear of evil spirits. The feeling of shame is not inborn in mankind and it assumes very different forms in different regions. A remnant of the superstitious fear connected with the act of taking food appears in the ejaculation "Prosit!" which, in Germany, is religiously uttered by the companions of a man who is about to take a drink. This Latin verbal form, the general meaning of which is "may it be beneficial" is now understood simply as the expression of a wish that the drink will agree with the drinker's constitution, but it originally connoted the hope that the drink had not been bewitched.

These statements are made by a writer in *Hygeia*, who adds that the division of labor between men and women was originally, and still is among primitive peoples, much more sharply defined than it is at present in civilized countries. This sharp division of labor brought about a separation at meals. The Eskimos have separate dishes for the two sexes, and a man would be deeply ashamed to eat with women. It is possible that the decoration of plates and cups was designed to serve as a counter-charm, as well as an ornament. When the fear of demons had passed, the custom of eating in private which that fear inspired was sometimes maintained by force of habit, so that eating in public came to be regarded as a shameful breach of good manners.

Our Merchant Marine and the South American Republics

First-class Ships as an Aid to Closer Commercial Relations

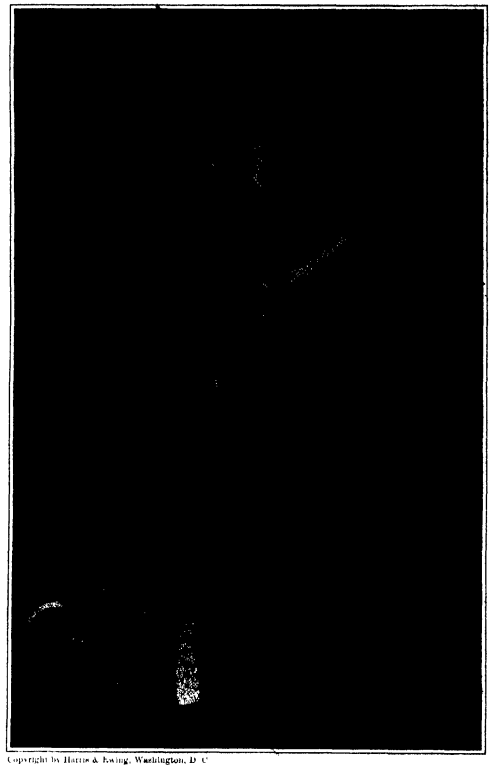
By the Hon. John Barrett, Director-General of the Pan-American Union

THIS is not an argument for or against so-called subsidies. It is a simple discussion of the subject of steamship connections between North and South America, without reference to partisan views or political policies. In the first place, there stands out a fact which is pre-eminently true: First-class steamship facilities for the exchange of trade products and the carrying of passengers and mails are just as necessary between countries separated by the high seas as first class railroad facilities for similar purposes between countries and states separated only by boundary lines. The better the railroad facilities the greater the trade exchange, the more travel, and the more frequent the mails. Correspondingly, the better the steamship facilities the greater becomes the commerce, the more general the travel and the more frequent the communication between countries and peoples widely apart.

Before developing further this subject in its relation to Latin America, one or two points should be cleared up. The statement is being continually made by those not familiar with the situation that trade between the United States and its sister republics can not be built up until it enjoys greatly improved steamship service. And the common supposition seems to be that not only passenger but freight lines are lacking to take care of the possible business. While it is true that there are few passenger or freight boats flying the American flag, there is a large fleet of vessels flying foreign flags and conveying the traffic back and forth between North and South America. The high class fast passenger vessels of any flag running to the southern part of South America are indeed limited in number compared to those which ply between that part of the southern continent and Europe, but the number of freight vessels running from New York city, for example, to all sections of Latin America is sufficiently large, and their sailings are frequent enough, to take care practically of all the freight that is offered, and for the most part at rates fairly competitive with those of Europe. The only adverse criticism from the standpoint of the United States that can be made in regard to this situation, is that very few of these vessels are under the American flag, although there is no security that, even if they were, the rates would be any lower than they are at the present time.

Surveying the field from the north and working south, we find the conditions generally much better than the average man supposes. Every important port on the Gulf and Caribbean coasts of Mexico, the Central American republics, Panama, Colombia and Venezuela in northern South America, Cuba, the Dominican Republic, Haiti, and the West Indies can be reached by the vessels which provide abundant freight space and fairly good passenger accommodations and in some cases the latter are excellent. Vessels are constantly running back and forth between these ports and New York city, Boston, Baltimore, New Orleans, Mobile and Galveston. One line has recently made such improvement in its passenger arrangements out of both New Orleans and New York that there has been a gratifying increase in the number of passengers it has been carrying to and from ports on the Caribbean and the Gulf of Mexico.

Considering the east coast of South America, under which are comprehended Brazil, Uruguay and Argentina and such well-known ports as Rio de Janeiro, Montevideo and Buenos Aires, it can be noted that there are abundant freight facilities for all the business that is offered either way. The passenger accommodations on some of these vessels have been greatly improved during the last two years, and still more notable advancement is to be made in the future. It is no longer necessary that the traveler, who wishes to be comfortable, should go to the east coast of South America by the way of Europe, if he is not too anxious to sail without any delay. In other words, if he is willing to adapt his sailing to certain vessels, he can, at least once or twice a month, get very good boats direct from New York to Rio de Janeiro and Buenos Aires. It must be admitted, however, that, if he is in a hurry, he can usually do better by proceeding directly to Europe and taking one of the fast English, German or French steamers.



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HON. JOHN BARRETT
Director-General of the Pan-American Union.

Considering the west coast of southern North America, that is of Mexico and Central America, and the republics bordering on the Pacific of South America, we find that there are fair facilities both for passengers and for freight from Panama south to the ports in Colombia, Ecuador, Peru, Chile, and, via both Peru and Chile, to Bolivia. Steamers leave at least once a week from Panama for such ports as Guayaquil, Callao, Mollendo, Iquique and Valparaiso. There has been much improvement of late in these routes, new steamers having been put on by the lines operating, while others are to be placed in commission as soon as constructed. The service between the Pacific coast of the United States and the west coast of Mexico, Central America and Panama is somewhat limited, but seems at the present time to take care of nearly all the business that is offered. There is no question that these lines will be improved by the time the Panama Canal opens, and several companies, planning to enter the field, are now only awaiting developments in connection with canal tolls to decide what they will do.

What I desire to see, as an international officer, is not only more steamers put on flying the American flag, but more flying any flag. The greater the competition and the more vessels there are, the greater will be the effort of business interests to get into the field. The buying and selling between North and South America will grow with better steamship facilities, no matter what the flag, just as trade grows on land between different States and citizens with better railroad connections between them. Perhaps I am not as strong as I should be for special laws in favor of the shipping of the United States, because in my capacity as a Pan-American officer I want to see the countries of Latin America, like Mexico, Peru, Chile, Argentina and Brazil, putting on vessels which will ply between the ports of their countries and those of the United States. I think it would be unfortunate to discriminate in shipping tolls through the Canal in favor of the vessels of the United States unless they are engaged in the coastwise trade. In other words, I believe it would be a cardinal error to allow a vessel flying the United States flag plying, for example, between the United States and Chile, to have any advantage in canal tolls over the vessel flying the Chilean flag which might do business between Chile and the United States. It is to be hoped that there will not be any legislation which would discriminate against ships of other nations going through the Canal and engaging in international commerce. Such action of the United States might naturally be considered by the twenty countries lying to the south of us as being adverse to international comity and the development of friendly relations.

Viewing some practical phases of the situation, we can not overlook the necessity of having the best arrangements for the exchange of mail. The more frequently and the more rapidly letters, papers, reports and other data can be exchanged between the United States and all the countries to the south of it, the more rapidly will trade develop. The European countries have benefited enormously from excellent mail facilities with Latin America, and the business men of the United States will find when this handicap is overcome that a great increase in their trade will result. It must also be borne in mind that there is no better way of developing trade than the mutual acquaintance of both buyers and sellers. If the steamship facilities between the United States and Latin America are so improved that the average business man and tourist of the latter can travel to and from the former with the same speed and comfort that he can travel to and from Europe he will go to the United States, get acquainted with its people, its institutions, its business men, its conditions of trade, and will both purchase and sell there to a far greater degree than ever before. The importers of Latin America, enjoy combining business with pleasure, and, in seeking the combination of both, they find the steamships which take them to and from Europe offer greater inducements than those which take them to

and from the United States, although of late, in response to the efforts of one company to better its service, there has been a notable change in favor of visiting the United States. The conclusion must be that the more this service improves the more will Latin Americans come to the United States. Correspondingly, a large element of American exporters and business men who now visit Europe or Asia will go only too readily to Latin America when they realize that they can travel in comfort. The knowledge that the facilities are already much better than they were formerly has resulted in a considerable increase of Americans going directly to Latin America from New York, New Orleans, and San Francisco, and there are indications that the travel next year will be far larger than ever before.

As supporting the contention that improved steamship service will not fail of appreciation by the business interests of North and South America, it is well to bear in mind some of the present conditions of Pan-American trade The great majority of the people of the United States do not realize how extensive already is the exchange of products between North and South America, and how rapidly this business has developed during the last ten years Too many manufacturers, merchants, importers and exporters, who have not studied the field and the facts, are inclined to pooh-pooh its importance and opportunity, and therefore make no effort to enter it. The truth is that the export and import trade of the United States with the twenty Latin-American countries lying to the south of it has grown with remarkable and gratifying rapidity during the last ten or fifteen years. If it has been able to make this advance under what are generally considered adverse steamship conditions, it must be admitted that it will make far greater progress in the future, when these facilities are extended and improved

The total annual value of exports and imports exchanged between the United States and its sister republics approaches now six hundred and fifty millions of dollars. Fifteen years ago it did not exceed two hundred and fifty millions of dollars This means a remarkable growth of four hundred millions of dollars in little more than a decade This, in turn, is a percentage not surpassed by the trade of the United States with any other section of the world, and in startling comparison with the trade of the United States with Asia, which has practically stood still, and, in the case of some countries, has actually decreased

The evidence that this annual commerce of six hundred and fifty millions of dollars has an opportunity of expansion is shown in the fact that the total foreign trade of Latin America exceeds now two billions of dollars per annum The share of the United States therefore is greater than one-fourth—certainly a condition against which there can be little complaint when we consider the activity of the business interests of Great Britain, Germany, France, Belgium, Holland, Spain, Portugal, and Austria-Hungary

As a specific illustration of the value of Pan-American foreign commerce, the foreign trade of Argentina can be cited Last year this exceeded seven hundred millions of dollars, an average of nearly one hundred dollars per head, and larger than the foreign trade of either Japan or China

In studying these figures of Latin-American trade, it is interesting to note what may be the opportunity for steamships plying through the Panama Canal The five countries which form the western or Pacific slope of South America, including Colombia, Ecuador, Peru, Bolivia, and Chile, last year bought and sold with the rest of the world a commerce valued in excess of three hundred millions of dollars If they can conduct a business of this size, despite their isolated position, they should be able to double it within a few years after the opening of the Canal, and the share of the United States in view of its new proximity brought about by the Canal, should grow more rapidly than that of any other country There will be a demand for an increased fleet of vessels to run directly between the principal ports of the Atlantic and Gulf coasts of the United States and those of the western shore of South America, which reaches for five thousand miles from Panama to Punta Arenas There will also be a demand for more vessels to communicate through the Canal with the west coast of Central America and Mexico, which reaches for nearly three thousand miles from Panama to San Diego This section of Latin America, that is, the portion bordering on the Pacific Ocean, now conducts a foreign commerce in excess of one hundred millions of dollars per annum—a total which will double within five years after the Canal is opened if there are satisfactory steamship facilities

The Present Status of Cancer Research

By Dr. Moyer S. Fleisher, Barnard Free Skin and Cancer Hospital, St. Louis, Mo.

IT is now scarcely ten years since the experimental investigation of the cancer problem was first entered upon, and therefore we are to-day only on the threshold of a true and definite knowledge regarding cancer While for many years, indeed, since the first half of the last century, the problems of cancer, its origin and nature, have occupied the thoughts of investigators, it was not until the early part of this century, under the stimulus of successful experimental work carried out by Loeb (an American investigator) on rats, and later, though independently, by Jansen (a Danish investigator) on mice, that general interest was awakened in this subject.

Before this time almost all investigation concerning cancer had been limited to the microscopical examination of these tumors and by means of this examination cancers had been classified, and there developed as a result of these investigations a multitude of purely hypothetical theories regarding the cause of cancer.

It may be advisable to pause here and define what a cancer is A cancer is a mass of cells, whose origin is from the cells which normally constitute our bodies The structure of the cancer cells is similar to that of the normal cells These cancer cells, unlike normal cells of the adult body, have the power of very rapid growth or proliferation In the course of this rapid growth the relationships of the cancer cells to one another, or to neighboring cells, deviate to a greater or less degree from those of their parent cells. They not only break through their normal boundaries, and invade and destroy the surrounding normal tissue, but also individual cells or masses of cancer cells may be carried in either blood or lymph vessels, to parts of the body distant from their site of origin, and may there continue their rapid growth and constitute secondary cancers, which are spoken of as metastases

Under the general term of cancer we group all abnormal malignant growths which have the above characteristics; however, there are two distinct types of cancer. It must be clearly understood that the body is composed of many different kinds of cells, and that various groups of specialised cells form what we call organs. It is, however, possible to group these cells under two headings; the first are called epithelial cells; under this group are included the cells lining the alimentary tract, and the air passages, the superficial cells of our skin and the more important cells of the glands within our bodies. These epithelial cells give rise to a type of cancer which we call carcinoma. The second type of cells, which form the supporting and connecting structures for the epithelial cells, are called connective tissue cells, and give rise to a type of cancer called sarcoma.

During the years that our knowledge of malignant growths was being obtained only by means of the microscope, various theories were advanced to explain both the origin of and the phenomena connected with cancer. The theories which were advanced may be roughly divided into two groups

In the first of these the cause of cancer was said to be a pre-natal influence on either single cells or groups of cells Thus Cohnheim believed that during the time of embryonic development groups of cells were separated from their normal relations within the developing body, and, until some stimulus or impulse set them into activity, these groups of cells remained quiescent When once set into activity they again took on their embryonic quality, namely, power of rapid proliferation, and now developed as a cancer

While this theory serves to explain at least in part the origin of certain tumors, it fails to explain the origin of the true malignant tumors which we speak of as cancers. Ribbert holds that during the pre-natal period, or during the adult life, cells may be split off from their usual surroundings, and now take on the power of unchecked growth which we may consider as one of the characteristics of cancer

In the second group are those theories in which the cause of cancer is supposed to be an acquired abnormality, a change within the cells of the adult body These changes are supposed to be represented by chemical, physical or structural variations of the cells, or again the cells are supposed to have taken on new functions or activities

While these theories might serve to explain the origin of cancer from individual cells or from groups of cells in the body, they fail to point why these cells acquire the qualities which we associate with cancer Many theories were therefore advanced to explain why either quiescent embryonic cells or even normal cells should suddenly take on the power of unlimited growth. Various investigators offered suggestions that the structure of cells was changed or influenced in certain ways, but none of these hypotheses were supported by definite experimental proof

It is only since it was first learned that cancer could be transmitted from one animal to another that our knowledge of this disease has been obtained by experimental means.

It has been known for many years that the lower animals developed cancers which were similar to those seen in human beings In certain kinds of animals cancers appeared more frequently than in others, and it was noted that in rats and mice may cases of spontaneous cancer occurred The term spontaneous cancer is used here in order to distinguish the cancers which arise *de novo* from the "inoculated" cancers, produced by grafting a portion of a spontaneous cancer on a normal animal The knowledge that a spontaneous cancer can be inoculated into many series of normal animals forms the keystone of experimental cancer research.

In transmitting cancer from one animal to another some of the cells of a cancer are grafted on a normal animal (usually in the loose tissue under the skin); these implanted cells of the first animal grow, divide and multiply rapidly, thus we have growing in the second animal a cancer composed of the cells of the first animal It must be distinctly understood that the cancer in the second animal is in reality composed of cells of the first animal and the cells of the second animal, as a rule, take no part in the formation of the cancer This inoculated cancer may then be transmitted to a third, fourth or even an unlimited series of animals, so that the cancer cells of the first animal may be transmitted through many generations of animals and may be kept alive long after the death of the first animal

The experimentation on animals has as yet not brought any definite results as to what may be the cause of cancer, although some very suggestive and unexpected facts have been discovered

What role heredity may play in either development or tendency to development of cancer is as yet uncertain, and the relatively small number of experiments which have so far been carried out in this line are only suggestions of future possibilities It has been noted that within a relatively short period of time three cases of a rare kind of cancer developed in one family of rats It seems more likely that these cases were due to some heredity factor than that they were due to infection As yet no systematic and extensive work has been carried out which allows of any generalization regarding the influence of heredity We know, however, that heredity plays a part in transmitting certain qualities which are favorable or unfavorable to the growth of transplanted tumors

For many years efforts have been made to show a causal relationship between micro-organisms and the development of cancer, and thus to prove that cancer is of an infectious nature, as diseases such as typhoid fever, diphtheria or tetanus

Certain statistical studies which show the prevalence of cases of cancer in certain districts, the occurrence of epidemics of cancer cases, or the repeated occurrence of cancer in certain houses, would seem possibly to point to such an origin, but on the other hand, in these cases, heredity and various other factors which must be taken into consideration cannot be excluded

It has been noted in a few cases that when animals were inoculated with a certain kind of cancer (in the majority of cases with carcinoma), there developed in the inoculated animal a second kind of cancer (a sarcoma) One may here consider that the cells of the inoculated cancer have carried the cancer parasite which has then exerted its influence on the second class of cells It is of course impossible to exclude the suggestion that the carcinoma cells may have acted as an irritant, and thus led to the development of a sarcoma from the neighboring cells

Many investigators have attempted to demonstrate specific parasites as the cause of cancer Bacteria, yeasts, and even mites have been cultivated from

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The Merchant Marine as an Auxiliary to the Navy

Navy Would Need Some Nine Hundred Merchant Vessels to Draw from in Case of War

By T. G. Roberts, Naval Constructor United States Navy

IN order to bring home to our people a realization of the true importance of the question of providing an adequate merchant marine, what force of words of arguments, or what array of facts and statistics are necessary, beyond the multitude already available that have but recently fallen upon unheeding minds amid unpropitious times?

A navy is not fully complete without those auxiliary vessels which only a numerous merchant marine can supply and a healthy merchant marine is the greatest need of this country to-day After the outbreak of war merchant ships cannot be improvised any more than battleships A nation that would pretend to be a world power could not hope actually to achieve such a position while neglecting those very instruments without which potentiality cannot possibly be maintained Aside from the lack of that instrumentality for trade which a merchant marine supplies, it is inconceivable that a country as great and rich as ours, with a government so liberal and enlightened could blindly neglect a source of sea power so essential, if we are to avoid in the event of war a possible defeat upon the sea, with the Philippines, the Panama Canal and the Monroe Doctrine at stake—a defeat that would not only cost us a great loss of prestige, but would be all but irretrievable in effect When the actual cost of providing an adequate merchant marine is considered not over $15,000,000 a year—it is all the more incomprehensible that we should neglect that balance of sea power now standing between us and an effective readiness and at the same time thereby contribute to foreign shipping companies the profits on carrying annually about $3,000,000,000 worth of imports and exports, at a cost of something like $300,000,000 a year, and furnish them with the trade to keep them in existence, with their vessels available to foreign governments, through foreign subsidies, to be used against us upon the outbreak of war Thus, in the item of merchant marine auxiliaries, we have not only handicapped our sea power doubly, but our merchant shipping has also become the laughing stock of all the world and the butt for jokes of the sailor men of all nations.

A Contrast in Preparedness.

At the outbreak of our Spanish war we had practically no naval auxiliaries, but Congress immediately voted $50,000,000 for the national defense Of course this money went for almost everything immediately or remotely connected with the prosecution of the war, all the way from the mobilizing of the army to the purchasing and fitting out of auxiliaries for the navy About one hundred merchant and other vessels were purchased and fitted out as naval auxiliaries, of which over half consisted of yachts and tugs Many owners showed the patriotic willingness to let the government have their vessels, but the figures at which they went were characteristic of the phenomenal increase in the stress of war times in the values of articles which a government must have, a condition which has grown proverbial in history Just how much these yachts and tugs and second-class merchantmen contributed to the victory is difficult to estimate, but it is safe to say they could not have filled the vacancy caused by the absence of an adequate merchant marine in case the war had been extended across seas, or in the case of any material resistance from the Spanish fleet, which by its predestined collapse rendered the naval auxiliaries a question of minor importance How different with the merchant marine of Japan in the late Russian war' The following quotations were taken, with approval by the Merchant Marine Commission from the *Nautical Gazette* of January 26th 1905, containing an editorial from the *Japan Daily Mail*, relative to the steamship lines We read that "despite the disadvantages to which the Nippon Yusen has been put by reason of the war, the company has been able to pay its shareholders a dividend of 12 per cent The *Japan Daily Mail* says 'We cannot dismiss the subject without noting the situation in which the country would have been placed had the outbreak of war found it without the splendid transport facilities by the Nippon Yusen Kaisha's fleet In the piping times of peace unreflecting persons are apt to look askance at the great shipping companies which received a substantial measure of state aid and show enviably prosperous balance sheets But the truth is that such companies are just as essential to the safety and independence of the empire as are its army and its navy Without them, indeed, the army's field of potentiality is strictly limited to domestic territories, and in Japan's case it may be truly said that did she not possess the Nippon Yusen Kaisha she would have to submit tamely to compulsory exclusion from the continent of Asia, and to see Manchuria and Korea pass finally under Russian sway' Americans as a rule have admired and applauded Japan in her endeavor to rise to a position of strength as a modern nation. That her wisdom in creating a merchant marine has been so well justified in the present war should be a cause of congratulation. The United States can take a lesson from Japan's experience"

Of our ten foreign-going merchant vessels flying the American flag, only the four of the American Line have the benefit of mail subsidies under the law of 1891, and are available for naval auxiliaries The coast-line shipping is absolutely protected by laws practically prohibiting foreign vessels from participation, the rates being determined from competition with the railroads, and so, are absolutely independent of and incomparable with the foreign ocean rates. Though fully protected by law, but not by subsidies, these coast steamers are under no obligation to the government, and are not necessarily available for use as auxiliaries in time of war.

The General Board of the Navy Department, in 1905, responding to an inquiry from the Senate relative to the number of naval auxiliaries needed from a merchant marine, reported that, at that time, with the twenty-seven battleships then in prospect and the other ships available, the navy would need 171 auxiliaries to be drawn from the merchant marine in order to go to war properly With respect to this number, the board said' "In order to be sure that this number of vessels would be available for immediate purchase or charter by the Navy Department at the outbreak of war, the number of American-owned merchant vessels of each type should be largely in excess of the number here given, as some vessels would be abroad when needed, some under repairs, and some should be left for carrying on their regular commercial runs and as a reserve from which to draw in case of necessity . . . Another benefit which would accrue to the navy from a large fleet of American-owned vessels would lie in the large number of experienced sea-going men, engineers, and firemen accustomed to marine engines and boilers, who would form a valuable reserve from which to draw the men for manning the auxiliaries"

Supposing we had a merchant marine adequate for us to draw, say, one-fifth for immediate purposes, that would require a total merchant shipping of 855 vessels We have four now available and might be able to purchase, say, 100 vessels of the smaller classes, as in the case of the Spanish war It will thus be seen how far we are from possessing the auxiliaries absolutely essential to prosecute a foreign war In the event of such war the forty-nine colliers under foreign flags that supplied the fleet with coal during their voyage around the world would be unavailable by the mere operation of the laws of neutrality, and their places would be supplied by a vacancy which would strike our fleet with such force and such emphasis as would cause the American people to wake up and indulge in somewhat belated serious reflections.

In the event that troops should have to be transported across the seas the need of suitable vessels for army transports would be even more imperative than the naval auxiliaries. In 1905 the Army War College reported for the information of the Merchant Marine Commission that, to provide for an expedition of two divisions from either coast, an aggregate of 228 vessels, available in fifteen days, on both coasts, would be required If such a levy should call into immediate service say one-fifth of our imaginary merchant marine, that would indicate a merchant marine of 1,140 vessels to draw from I have said one-fifth at the first draw, because the merchant marine would have to supply additional vessels for subsequent needs in numbers depending upon the duration of the war and the casualties; and, furthermore, because no country expects to divert its entire merchant marine to the purposes of war, but of course plans to carry on its commerce with other nations during the war. Adding the 1,140 vessels necessary to supply the army needs to the 855 or navy needs, makes a total of 1,995 vessels of suitable size and speed which our merchant marine should contain. These figures are liberal, and provide an ample supply, and might be reduced to a minimum of one-fifth, or say 400 vessels, based on the assumption that the first expedition would be sufficient, and that all these vessels would be positively available to the government for war purposes, and that our corresponding commerce should cease during the war Comparing this minimum with the four merchant vessels now available, plus the few transports belonging to the army and the limited number of auxiliaries belonging to the navy, we find ourselves poor indeed.

The Foreign Shipping Interests.

Such a pitiable condition is all the more grievous from the outlook toward remedial legislation, and when we contemplate the enlightened but ineffectual efforts that have been expended now these seven years past with only a retrograding effect, we are torn with conflicting emotions—on the one hand with solicitude for the future preservation of our as yet untarnished national escutcheon; on the other hand with admiration for the foreign shipping interests, and the power and influence they have been able to wield so effectually in a country foreign to their own. Out of the congressional revelations of last year it developed incidentally that the foreign shipping interests control in the main practically all the commerce between this and foreign countries, both on land and sea, by rail and steamer, and that this control is exerted by a gigantic trust, with headquarters in Germany, that kills competition by Standard Oil methods. It is understood the government has entered suit in the Court of Equity under the Sherman anti-trust law against this monopoly in the manipulation and control of the passenger business, and the foreigners have taken the ground that this government has no jurisdiction over a foreign corporation The recent decision of the Supreme Court in the case of the Tobacco Trust, which applied the Sherman anti-trust law with full force to the two English companies doing business in this country, now renders it a foregone conclusion that the foreign shipping trust, both in its passenger and freight combines, will be ultimately dissolved as far as evidences of it are available on our shores, but it ought to be realised that, thereafter, such evidences must be necessarily very intangible and inconclusive "The mountains have labored and a ridiculous mouse will be born" Whatever becomes of our prosecution of the foreign shipping trust, though it be actually dissolved, which is hardly conceivable, and though by such dissolution the conditions may render possible the upbuilding of competing lines, yet those conditions alone will not produce an American merchant marine, unless and until our government shall plant the seed by new legislation, and cherish and protect the plant with favorable laws Else, the foreign grip upon our ocean shipping will remain unshaken; and to loosen it at all now will require a new birth of patriotism all over this land, sufficient to shake off this lethargy and awaken our people to a realization of their true condition of subserviency to the foreign shipping interests.

Ways and Means.

Notwithstanding the prejudice, both inspired and innocent, existing in this country against ship subsidies, it remains a fact that subsidies are the instrumentality through which existing merchant marines have been created and maintained. Subsidies and merchant marines are inseparable companions.

The constitution of the United States provides that treaties with foreign nations are a part of the supreme law of the land, and hence they cannot be set aside by a mere statute. There is now a clause in the Dingley tariff law which discriminates in favor of goods brought in American ships, but it is a dead letter, and has been set aside by the Board of General Appraisers as conflicting with our treaties. Discriminating duties must be preceded by the abrogation of about thirty treaties with foreign nations. The difficulties involved, together with the risk of retaliation, render that course well-nigh impracticable, though not impossible. Heretofore the advocacy of discriminating duties has been a means of opposition and of procrastination; with the present composition of Congress, however, it becomes not only a possibility but a live proposition. It is quite conceivable

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Clearing the Ocean Highway

The Derelict Destroyer "Seneca" and Her Work

By Walter Bernard

Of all the perils which beset ocean navigation, perhaps the most insidious, because the most elusive and difficult to guard against, is the derelict—the abandoned and almost submerged, but still floating wreck. When a vessel of stout construction, particularly if she be built of timber, is loaded with a cargo that is lighter than the water, she may sink until she is in the awash condition, and, by virtue of the strength of her hull, may hold together for many years, floating hither and thither at the caprice of wind and tide, and so constitute a perpetual menace to navigation. The ever-shifting wreck is naturally uncharted; and although a vigilant watch by day may suffice to detect the danger, in the night time the obstacle is quite invisible, and should it lie in the direct track of a ship a collision is unavoidable.

Unquestionably the floating derelict has been answerable for not a few of the unexplained losses of staunch and well-found ships, instances of which are too many and well known to need any recapitulation here.

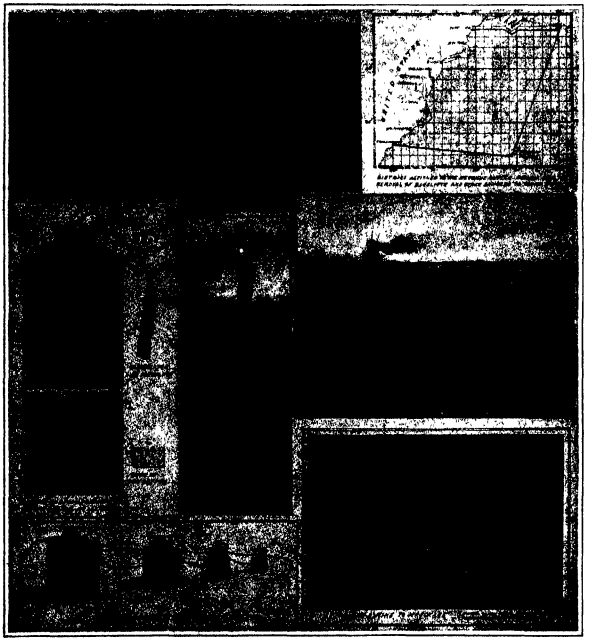
The endurance of the derelict and the extent of its ocean wanderings are almost unbelievable. Take the case of the Norwegian bark "Crown," lumber-laden, which was abandoned in a supposedly sinking condition in mid-Atlantic on December 26th, 1909. In the following May it was reported as on the edge of the Sargasso Sea, and at a later date it was sighted upon the other edge of the sea, having traversed in the interval eleven hundred miles. In the summer of 1910, it was sighted between Charleston, S. C., and Bermuda.

Take, again, the case of the "Fannie E. Woolston," which was wrecked on the Jersey coast October 15th, 1891. During the following three years the wreck was frequently sighted; once off the coast of Africa, and later on the opposite side of the Atlantic, off the coast of Florida. Finally it dropped entirely out of sight.

Lloyds, of London, has developed an effective system for tracing ocean derelicts, and whenever one is sighted in any of the seven seas, it is reported to headquarters, and means are taken to intercept and destroy it.

We present illustrations of the "Seneca," a deservedly popular vessel, which was recently built for the United States Revenue Cutter Service, for the purpose of patrolling the seas contiguous to the Atlantic coast and locating and destroying both derelicts and sunken wrecks that are a menace to navigation. The patrol ground of the "Seneca" lies within a line drawn from Charleston, S. C., to just west of the Bermuda Islands; then northeast to Sable Island, and from thence westerly to the coast of Maine. Generally speaking, the vessel has no particular orders, but is free to go and come when and where her captain, George C. Carmine, may think fit. Her specific duty is to locate and destroy wrecks, and to render assistance to vessels which may be in distress whether ashore or at sea. Her home station is Tompkinsville, Staten Island, to which reports of the sighting of derelicts are brought in by shipping or by wireless, or by cable from Lloyds.

We present a series of engravings showing the methods adopted by the "Seneca" in destroying derelicts and floating wreckage. The explosive used is guncotton, which is carried in boxes, and is charged into copper canisters (mines) which measure 9½ by 9½ inches, by 12 inches in height. Each mine is loaded with 50 cubes of guncotton, each measuring 3 inches by 3 inches, by 2 inches in height, which are snugly packed within the canister, in the manner shown. In the center of the canister is a copper case containing a firing charge of dry guncotton, within which is a primer of fulminate of mercury, which is electrically detonated. Cables lead from the primer up through a threaded cap, beneath which is a rubber ball which, as the cap is screwed down, is compressed against the cables and forms a watertight joint. Rubber gaskets also serve to make a tight joint for the main cap which closes the top of the canister. A battery is used for firing. The canister as shown above is standard for all explosions, as many of them being used as is necessary to do the work.



The guncotton mines and the methods of blowing up wrecks and destroying floating debris.

CLEARING THE OCEAN HIGHWAY

To illustrate the destruction of a large sunken vessel, we show the blowing up of the wreck of the three-masted schooner "Belle Halliday," which when loaded with paving stones was sunk on Pollock Rip Slue. The hulk was lying across the tide. To destroy this wreck a series of mines (canisters) was slung on a continuous cable, which was hung between two boats. The boats were rowed into a position alongside the wreck, with the cable stretched between them. The cable was then lowered to the bottom, when it was swept by the tide in under the bilges of the ship, in a position favorable for doing its work. The firing cable was then paid out to a distance of about 800 feet and the whole charge detonated. The ship was literally torn to pieces. For the destruction of the smaller floating obstacles such as deck houses, it is generally sufficient to suspend a single canister beneath the object, in the manner shown in one of our engravings.

A frequent and dangerous obstruction is the floating mast, which generally is found bottom upward, with a portion of the mast showing above the surface and the heavier end of it, containing the heavy masthead iron fittings and gear, floating many feet below. In this case, a mine is suspended on a heavy chain ring, which is placed over the mast and allowed to slip down to its bottom. The crew row off to a distance of several hundred feet, paying out the firing cable as they go, then, by pressing the button, the mast is shivered into splinters.

It should be explained that for the destruction of the hull of a ship, as in the case of the "Belle Halliday," the mines, each of which contains 40 pounds of guncotton, are placed generally about 25 feet apart, and as a rule about eight mines form the limit in a single series. Of course, the weight of the charge varies with the size and strength of the ship. Thus, in the case of the "Anglo African," which was stranded four miles south, half east, of Cape Charles lighthouse, with her bridge deck awash and only the mainmast standing, it was necessary to employ twenty-seven of the guncotton mines to insure her complete destruction.

The blowing up of derelicts and the destruction of wreckage however, by no means represents all the duties of the "Seneca." Her work in the salvage of ships and the saving of human lives has been arduous and highly meritorious. It will be remembered that several times during the past winter she did noble work of this character.

Bacteria as Indicators of Soil Acidity

THE longer a soil is used for producing crops, the more acid it accumulates. As most cultivated plants cannot thrive in an acid soil, it becomes necessary to employ larger and larger quantities of lime for neutralizing the increasing soil acidity. It thus becomes desirable to have a convenient method for determining the acidity of agricultural soils. The chemical methods heretofore used are cumbersome and unsatisfactory.

Prof. J. G. Lipman of Rutgers College has been conducting experiments with a view to finding a more expeditious and more reliable method for determining soil acidity and has obtained some interesting results by employing bacteria. His method rests upon the well known fact that bacteria will not multiply in a medium containing more than a certain percentage of acid. By comparing the growth of bacteria in a number of bouillon preparations to which varying quantities of sterilized soil have been added, it may be readily seen at what point the growth of the bacteria is stopped and accordingly the amount of acid in the soil may be calculated. In one set of experiments ammonia producing bacteria were used. A known quantity of soil is added to the bouillon, and after the action of the bacteria has proceeded a certain length of time the ammonia is distilled into standard acid and the amount determined. The amount of ammonia produced would vary inversely with the acidity of the soil, since the more acid there is in the soil the more would the activity of the bacteria be restrained. Other experiments were made with nitrifying bacteria in nitrogen-free media, the amount of nitrogen produced being used as an indication of the absence of acids.

Designing and Constructing an Ocean-going Steamer

How the Form, Size, Speed, Engine Power, etc., of an Ocean Steamer are Determined

By W. A. Dobson, Naval Architect William Cramp & Sons Ship and Engine Building Company

It is the intention in this article to deal with the design and construction of an ocean steamer, as nearly as may be, from the viewpoint of a layman. To tell how the successive operations of design and construction are carried on without entering into an explanation of the more or less abstruse principles involved.

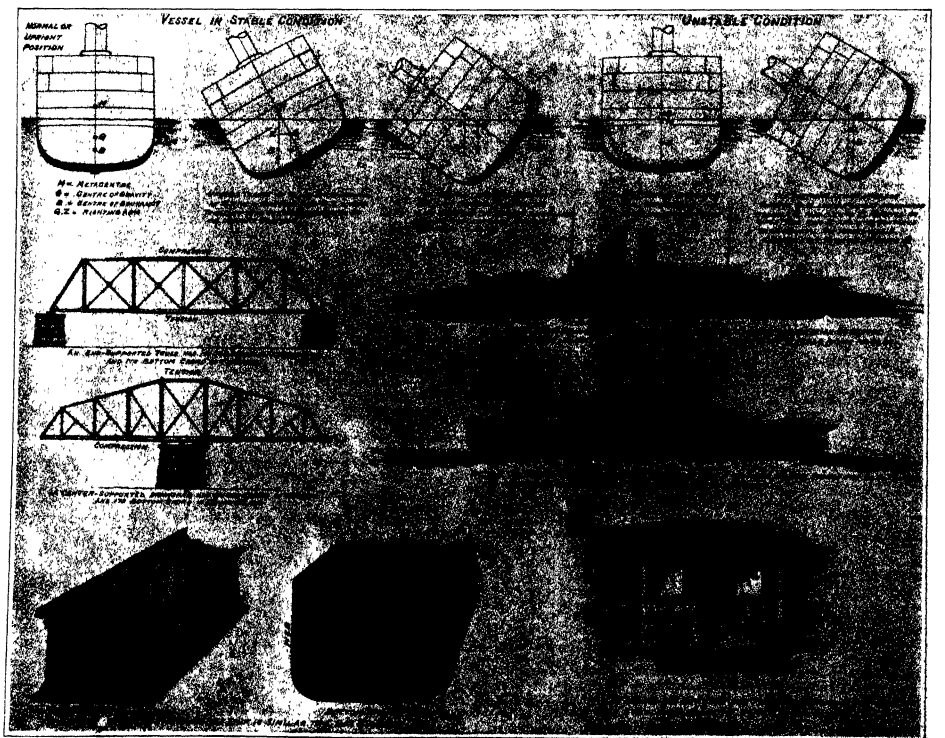
The starting point is of course the requirements of the owners. Every steamship line has its own traditions, practices and customs which must be adhered to. There are, however, certain fundamental requirements which determine the size and character of the vessel. First among these is the deadweight, or, in other words, the amount in tons of cargo alone to be carried, and its general character. Next comes the number of passengers in the first and second classes and in the steerage, for whom quarters must be provided. Then the speed necessary to maintain a given schedule between the ports of entry, and the length of route covered, in order that an adequate supply of fuel may be carried. The facilities and character of the terminals must also be considered, not only from the standpoint of handling the cargo properly, but often from the fact that the depth of water obtainable must determine the very important feature of the draft of the vessel. Another feature of great importance to the welfare and comfort of the patrons of the line is to so design the vessel as to suit the climatic conditions of the route. Having this information, therefore, given us, we are ready to approximate the displacement of the vessel in the light and fully laden conditions. It is evident that the displacement of the vessel, or its weight, at a given draft must be equal to the weight of the hull with all its equipment and outfit; the machinery and all its auxiliaries; the weight of the passengers and necessary stores; plus the weight of the fuel, and the weight of the cargo carried on that draft.

It remains, then, to determine the dimensions of the vessel and the power required, in order that the weight of the hull, machinery and fuel may be accurately calculated. For reasons given above the draft is fixed, leaving two dimensions, or the length and beam, which may be varied according to the conditions to be met. For a given speed there is a length below which it is not desirable to go, it being essential to obtain the most economical expenditure of power in driving the vessel. On the other hand, if this limit of length is largely exceeded the skin friction is greatly increased. To obtain the necessary room for passenger accommodations and capacity for cargo, it often happens that this limit must be exceeded, and the resulting increase in resistance accepted. Upon the breadth, or beam, depends largely the initial stability of the vessel, or the quality of remaining upright in still water. The safety of the vessel therefore, fixes the minimum beam to which we may work.

We find, then, a limit in length and in beam below which it is extremely undesirable to go. It may very well happen, however, that these minimum dimensions will not give the necessary displacement or the fineness of form desired. It is then that the experience and skill of the naval architect must be displayed in arriving at dimensions which afford the necessary volume, seaworthy qualities and form of least resistance.

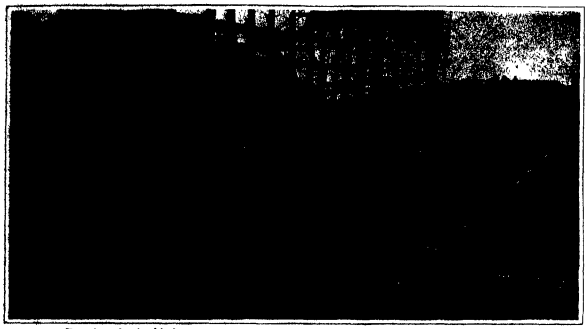
There is still another factor to be considered, and that is the depth of the vessel. The proportion of depth to beam and length affects the strength of the vessel in a marked degree. The structure for purposes of strength must be dealt with as a girder wherein the decks form the top flange and the keel, longitudinals and bottom plating the bottom flange, the side plating forming the web of the beam or girder. It can readily be seen, then, that the strength increases as the square of the depth. Under any circumstances, however, the depth must not be less than the draft plus the amount of freeboard required by the registration societies, or the freeboard necessary to comply with the Plimsoll markings. Should it be necessary to classify the vessel in one of the registration societies it may be necessary to modify the dimensions slightly to obtain a more economical arrangement of structural material, as the scantlings or the plates and shapes entering into the structure, are determined by certain rules governed by functions of length, breadth and depth.

Having settled upon the dimensions and practically upon the displacement, or within such limits as may readily be taken care of by a slight variation of the block coefficient, as the measure of the fineness of form is called, we enter upon a careful determination of the power necessary for the required speed. In all shipyards of experience extending through a score or so of years, power and speed data taken from voyages and trial trips have been carefully recorded and tabulated. These cover a great variety of forms and types of vessels. Selecting from this source the data pertaining to a ship similar in form and proportions to the vessel under design, we are able by applying Froude's law of comparisons to arrive at



The length of 600 feet for ship supported at ends is only approximate, for the stresses given.

PROBLEMS OF STABILITY AND OF THE BENDING EFFECTS OF THE WAVES



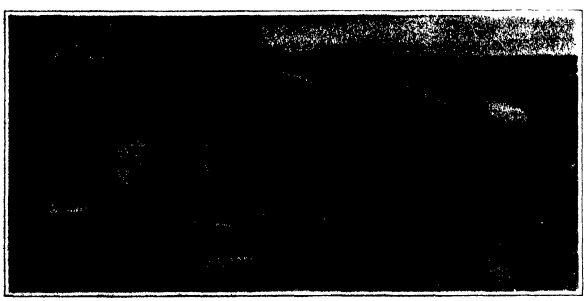
Framing the double bottom.

a very close approximation of the power required, so near, in fact, as to settle the weight of machinery and amount of fuel needed and thus finally fix the exact displacement. The plans of form, or, as commonly called, "lines," are then prepared, embodying the designer's best judgment as to the most suitable underwater form to give the least resistance. The "lines" are then sent to one of the experimental model basins, one of which is owned and controlled by the Government at Washington, and the other by the University of Michigan. Here a model is made from them, and its towing resistance at varying speeds carefully recorded and plotted. From the model resistance the effective horse-power for the actual vessel is calculated. The result of the model experiment is the final word in so far as the power required is concerned. If the result is not satisfactory to the designer he will prepare another set of lines and try them, or make such changes as a careful observation of the model under test may indicate will lessen the resistance. When finally satisfied he may rest secure from all apprehension of a trial failure caused by insufficient power.

Three more qualities of the ship as a whole remain which must be investigated, and they are the strength, trim and stability. Most vessels are built



The ship in frame and plated.



The inner ring shows funnel, the outer ring the casing.

An elliptical funnel.

to be classed in some one of the registration societies, and where built according to their rules, if of the general type of construction provided for, very little apprehension need be felt regarding the strength. Occasions frequently arise, however, when a new form of construction is required to suit some particular type of vessel. It then becomes necessary to calculate the stresses coming upon the top and bottom flanges of the girder, when the vessel is either upon the crest of a wave or in the hollow, the wave chosen being of the same length as the vessel. In all conditions of the sea the vessel itself, considered as a loaded beam, remains practically the same, but the points of support are constantly changing. On the crest of a wave we have the beam supported in the middle with ends free, and in the hollow, the ends supported and the middle with little support. The estimated stress is arrived at only after complex and laborious calculations of too technical a character to be here described.

The trim of the vessel depends of course upon the relative positions of the center of gravity of the completed vessel, and the center of gravity of the immersed volume, or the part of the vessel in the water, commonly called the center of buoyancy. Both must lie in the same vertical line, and the vessel will necessarily assume such drafts as will satisfy this condition. To maintain a predetermined draft line it is necessary, therefore not only to accurately estimate the total weight but its longitudinal center of gravity as well. This must be done before the plan of form or "lines" is made, in order that the center of buoyancy may be properly located. Ordinarily, when fully laden, the vessel trims on even keel and by the stern when light.

There remains still the important feature of stability to be investigated, for upon the condition of stability depends largely the safety of the vessel. It may be said that there are three conditions of stability or equilibium in a body floating freely in still water, and these are stable, unstable and neutral. It is absolutely necessary to obtain the first of these conditions, and it depends solely upon the position of two points, one known as the transverse metacenter and the other the vertical center of gravity of the completed ship. The metacenter depends upon the geometrical shape of the underwater body, and the center of gravity upon the arrangement of the weights that enter in the *boat ensemble* of the vessel. The distance between them is known as the metacentric height. If the center of gravity is too far below the metacenter the vessel is too stiff and quick in rolling, making her extremely uncomfortable for her passengers, and if too small a distance is maintained the vessel is liable to be unstable. A reasonably small metacentric height, combined with high freeboard whereby a long range of stability is obtained, is found to give a safe, slow and deep rolling vessel, with the maximum of comfort to those on board.

There is still another condition of stability to

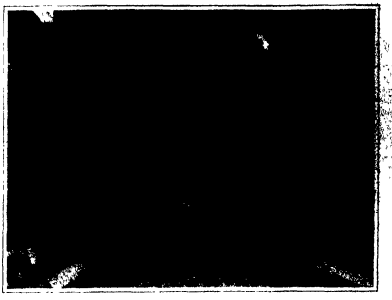


By driving in wedges the weight of the ship is transferred from the pontoons to the launching ways.

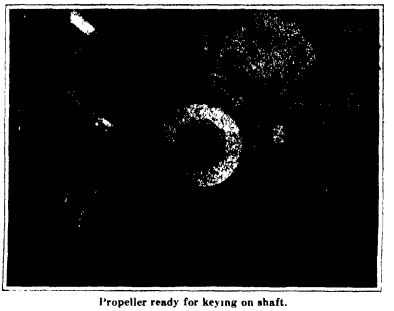
Wedging up preparatory to launching.

provide for, and that is when by accident the compartments at the ends of the vessel are flooded with water the change in trim shall not be so great as to submerge the upper watertight deck. This is provided against by the arrangement of the bulkheads at the extremities of the vessel, so as to keep the weight of water admitted and its free surface as small as practicable.

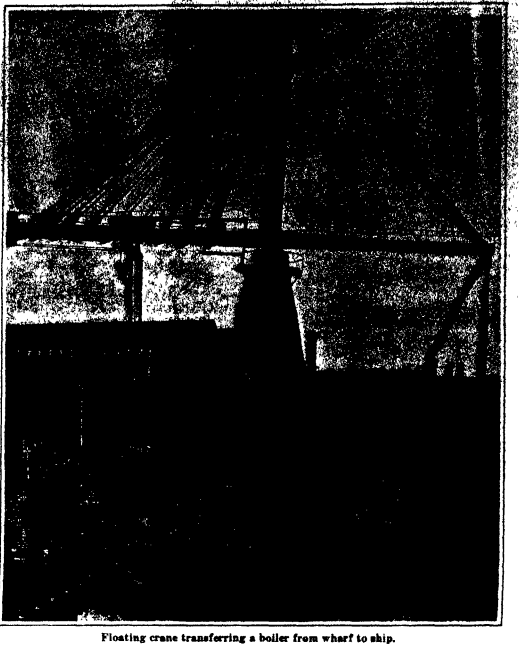
Almost all seagoing merchant vessels of the better class are fitted with Scotch boilers, arranged for heated forced draft. The motive power, however, is one that admits of careful study, the type chosen being governed largely by the wishes of the owners. For vessel over 20 knots per hour speed, the later-day tendency is, where vessels are running at



This Battery of boilers was placed in the Olympic



Propeller ready for keying on shaft.



Floating crane transferring a boiler from wharf to ship.



The launch of a large steamer

DESIGNING AND CONSTRUCTING AN OCEAN-GOING STEAMER

full speed, day in and day out, to arrange for steam turbines, although many owners stick to the old and well-tried triple expansion reciprocating engines. An excellent and most economical arrangement is a combination of reciprocating engines for the higher steam pressures, combined with a turbine for the lower.

Having settled upon the dimensions and form of vessel, the type of machinery and the accommodations for the passengers, we are ready to proceed with [illegible] material and getting the work in the yard. In this and those of all the structure of the vessel are made from which the material is manufactured, ready to be sent to the mills. Drawings of the [illegible] are prepared from which the patterns and [illegible] are made, and to which the different parts [illegible] are shaped in the shops.

The frames of the vessel are laid down full size on the floor of the mold loft from which the shape of each frame is taken. The frames come into the yard from the mills in straight pieces, which are heated and bent to the shape given by the molds. Molds or templates conforming to the shape of each frame and paper templates are made in the loft, from which the material as it arrives in the yard is laid off and planed and punched ready for erection and riveting.

The first step in the yard is to prepare the keel blocks for the reception of the keel As almost the entirely weight of the vessel up to the time of launching must rest upon these blocks, they must be of very substantial character, and should be laid upon piles with cement or timber caps so to prevent any settling of the blocks. As the vessel, when sufficiently finished, must be transferred from the building slips to the water, the blocks are laid with an inclination from the bow to the stern, to facilitate launching.

The next step is to lay the keel and the bottom plating, up to the turn of the bilge or beyond the margin plate of the inner bottom. Then the frames and the longitudinals within the double bottom are erected, and plated over with the inner bottom plating The side frames and stringers and the stem and sternpost are then erected and the bulkheads placed in position; then the beams are also placed and we are ready to put in place the side and deck plating Meanwhile the engine, boiler and shaft foundations have been built and the stern tubes and propeller struts secured in place The rudder is now ready for hanging and the vessel is so far completed as to be ready for launching.

This is one of the most interesting processes in building, for we have to transfer from the keel blocks to the water a structure weighing in some instances from twelve to fifteen thousand tons. Since the vessel as built rests upon the keel blocks and shores, it is necessary to raise the vessel up clear of them, and at the same time transfer the weight to a platform capable of being moved at will. The method generally used is to place on each side of the keel blocks a runway formed of heavy pieces of timber, made smooth on the upper surface, and framed together. The breadth is such as to support about two and a half tons per square foot of area when the weight of the vessel rests upon them. These timbers, called "ground-ways," are laid upon piled foundations parallel to the keel, and about one-third of the vessel's breadth apart. They extend from the bow down into the water sufficiently to have at least nine feet of water on their ends at high tide, and are set at a slightly greater inclination than the keel blocks When these ways are in position and properly braced and shored, their upper surfaces are coated with tallow and grease about five-eighths of an inch in thickness. Upon the greased surfaces are placed a similar set of ways free to move, when released, called "sliding-ways" These extend as far forward and aft as the form of the vessel will permit On top of the sliding ways and between them and the ship's structure a cradle is built conforming to the ship's form in the line of the ways Between the cradle and the sliding ways a multitude of long wedges are placed, which when driven up gradually raise the vessel from her building blocks, so that the weight rests upon the two greased surfaces, and is only held from moving by a heavy tie at the forward end of the ways, or a releasing trigger fitted with a hydraulic cylinder to throw it out of gear at the proper time If a timber tie is used holding the sliding into the ground ways, it is sawn asunder, and then the vessel is free to move down the greased inclined paths to the water

During the construction of the steel hull, work on the engines and boilers and joiner work has been pushed in the different shops so that the vessel as soon as launched is ready to receive her machinery and auxiliaries, and to have the passenger accommodations carried along to completion

The passenger accommodations include in their scope a small unit of almost all the plants common to a large city A water supply and drainage system must be provided; an electric plant capable of operating auxiliaries and thoroughly lighting the vessel is necessary; a ventilation system whereby fresh air is carried to all parts of the living quarters is provided; a refrigerating and cold storage plant must be provided for the preservation of fresh meats and vegetables, etc. In addition, all the conveniences fitted in a first-class hotel find their counterpart in an ocean liner There must be a laundry, with drying rooms, etc., all machinery for laundering; dish-washing machinery; a kitchen complete with ranges, boilers, steamers, broilers, warming tables, hot tables, meat-chopping and meat-slicing machines; bakery; printing office; a bar and wine room; public and private baths; barber shop, music rooms; library; lounging and smoking rooms In the first-class quarters a great field is open to the art of the decorator, who, in many instances, has produced notable examples of taste and proportion

All of these details must receive the care and attention of the builder, from the day the keel is laid until the vessel leaves his hands ready to start on an ocean voyage

Space forbids going into detail in connection with the appliances fitted and means provided to insure the safety of the passengers against fire, collision, or explosion Suffice it to say that each one of the dangers to be encountered is provided against in the most thorough and reliable manner, insomuch, in fact, that a large, up-to-date ocean steamer is about the safest place in which a person can be—though not to all people the most comfortable

Correspondence

Observations of a Wheat Student

To the Editor of the SCIENTIFIC AMERICAN

The writer is doing some experimenting in wheat growing that may prove of great scientific interest to the agricultural world along the lines of intensive wheat culture.

Fifty feet from my bedroom window (I am a shut-in crippled by a severe colotomy operation) I had planted a plot, 8 feet square, with six kinds of autumn wheat. The soil was good but hard-pan underlay it, giving me but 24 inches of growing earth A problem arose as to moisture sufficient to grow the wheat and sufficient plant food containing earth to nourish it I met the problems, and I see my wheat waving in the breeze, "heading" nicely and *above the 6 foot measuring rod.*

Liebig used human nitrates as a fertilizer, and increased the gluten in growing wheat from 10 to 31 per cent. A proposition of tremendous human economic interest when you think that a lean steak has but 20 per cent of animal "gluten" in it. Flour at 3 cents per pound; steak at 25 to 30 cents per pound.

I am using human nitrates in the fertilizing of this wheat. The growth is phenomenal, now it remains to be seen what the analytical chemist will find when the ripened kernels are sent to his laboratory

My theories are these: That with intensive culture (not the hit or miss trust-in-Providence methods now in use) and the proper fertilizers, our wheats can be intrinsically improved in a muscle-food building sense, and the *yields* greatly increased as well.

Lesinsky, so states the *Nova Vremyea*, grew from *one* wheat kernel planted at the apex of a funnel-shaped pit, 24 × 18 inches deep, lightly covering with earth the growing stem repeatedly until it reached the surface, 19,523 stalks of wheat, each bearing its quota of kernels! Phenomenal stooling. As the *Nova Vremyea* is a sedate Russian journal, not given over to *Punch* or *Puck* joking, one does a little thinking. Prince *Kropotkin* got, it is stated, 150 bearing stools from one kernel of wheat so growing. I am now to try out this "pit" experiment.

We are "up against it," agriculturally speaking, when our national wheat crop averages but 13 bushels as against England's intensively farmed wheat with a *yield of 32 bushels, and North Dakota's* average last year of 14½ bushels.

If my 8-foot farm yields a very high protein content in the wheat, and the fertilizing value of human nitrates can be duplicated in a commercial fertilizer, in a practical economical way, there is room ahead for scientific research as to applying better ways and means of producing our staff of life The very thought of increasing the food value in a loaf to twice or thrice its present state leans somewhat toward a reduction in the higher cost of living, for then man could, if he had to, live and live well and be perfectly nourished on "bread alone," upsetting the Biblical contention to the contrary

As my experiments progress, I may write you. I am doing what I can to exploit the soap trees of Mr Moulle of Jacksonville, Fla., in California A most useful and valuable tree seemingly

Point Loma, Cal. CHARLES CRISTADORO

Advantages of Forward Horizontal Rudders

To the Editor of the SCIENTIFIC AMERICAN

"Surface winds are well known to be oscillatory in character, i. e., subject to rapid variations of pressure, velocity and direction, altogether analogous to sound waves." (Page 422, SCIENTIFIC AMERICAN)

"The 'Canard' was practically the same machine with the body lengthened 5 meters in order to bring the horizontal rudder that much farther forward of the planes The above experimental glider, which was tested at Berck-sur-Mer when Voisin was experimenting with Capt. Ferber, was instrumental in giving the former the European record of duration as a glider" (Page 424, SCIENTIFIC AMERICAN)

Superiority of the horizontal rudder forward aeroplane being demonstrated but not analyzed in your article, I suggest the advantage of the horizontal rudder forward as a sustaining device is that it automatically lifts the front of the machine every time a gust strikes it, and has the main planes inclined upward before they are struck by the gust Similarly, it drops the front when the velocity of wind ceases. This seems a step in favor of prolonged gliding flight without engines. Practice in observing velocities and skilled adjustment of the forward horizontal rudder may bring us much nearer our dream of flight on so-called "sound waves"

I would suggest that experiments of this nature be made over the water for safety, horizontal position of aviator to reduce air resistance, and for the assistance the aviator would receive in seeing the gusts on the water before they struck his wings Assistance might be rendered from a boat with a string and reel, thus making the practice prolonged

Gliding is generally attempted on calm days for safety It should be attempted on gusty days for power Birds seem unable to glide any considerable distance on a calm day, except on conditions where an upward local current is found Such currents must be often formed on calm days on account of the sunshine warming the lower atmosphere

Denton, Md J. FRANK GELLETLEY

Dotted Guide Lines

To the Editor of the SCIENTIFIC AMERICAN:

In book catalogues and price lists, and elsewhere I have noticed the use of lines of dots, the purpose of these being to guide the eye from the thing to the number or price thereof For example

Bravo	C777-2
Afloat and Ashore	C777
Miles Wallingford	C777-15
Les Miserables	H895-3
Ivanhoe	S431-14
Redgauntlet	S431-22
Apples	40 cents
Eggs	30 cents
Potatoes	55 cents
Coffee	30 cents
Tea	65 cents

Since the lines are close together the eye is often confused and fails to pursue a straight course in passing from the thing to the number In order to assist the eye in keeping the line, and to increase the efficiency of the dots, I suggest the omission of every other line For example

Bravo	C777-2
Afloat and Ashore	C777
Miles Wallingford	C777-15
Les Miserables	H895-3
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Apples	40 cents
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Coffee	30 cents
Tea	65 cents

When the names and numbers are far apart, and especially if the type is small and the spacing is close, it may be well to retain only every third line

Buffalo, N. Y. ALFRED J. MILLER

Abstracts from Current Periodicals

Phases of Science as Other Editors See Them

Whale Meat as a Food

IN a recent number of the *National Geographic Magazine*, Mr. Roy Chapman Andrews, Assistant Curator of Mammals of the American Museum of Natural History, wishes that the European and American people could be educated to the point of eating whale meat or, as he puts it, canned flesh of animals yielding as much as 80,000 pounds of meat. This, it seems, is the point which Japan has reached: a country where thousands too poor to buy meat content themselves with whale flesh.

It was the invention of the harpoon gun in 1864 by a Norwegian Svend Foyn, that rendered this great supply of meat possible. Mr. Andrews assures us.

"With the further development of the harpoon gun grew up a new and great industry for it made possible the capture of a group of whales known as rorquals, or finners, in sufficient numbers to warrant the erection of stations at certain points on the shore where the animals could be brought in and the huge carcasses converted into commercial products. Previously these whales had been little troubled by the men who hunted in a small boat with a hand harpoon and lance, for the great speed of the animals and their tendency to sink as soon as killed, as well as their thin blubber and short, coarse baleen, made them unpopular with the early whalers.

"In a few years stations had sprung up on the coasts of Norway in every available place, and later reached across the Atlantic to the American shores. Newfoundland became the first hunting ground for the whalers here, and only a few years ago as many as eighteen stations were in operation on that island and the immediate vicinity.

"The great success of the Norwegian methods attracted so much attention that stations were erected in every part of the world where conditions were favorable—in British Columbia, Southwestern Alaska, Bermuda, South America, and the Islands of the Antarctic, on the coasts of Japan, Korea, Africa and Russia. Australia is soon to be invaded, and only a few months ago a company announced their plans for carrying on operations on a large scale in the Aleutian Islands."

In New Zealand, hump-back whale are being taken in wire nets, and so in nearly every part of the globe the world-hunt goes on. The inevitable result of this wholesale slaughter will be the commercial extinction of the large whales within a very few decades, according to Mr. Andrews.

The marvelous rapidity with which the enormous carcasses are handled and cut up is described by Mr. Andrews.

"A heavy wire cable was made fast about the posterior part of one of the whales just in front of the tail or flukes and the winch started. The cable straightened out, tightened, and became as rigid as a bar of steel. Slowly foot after foot of the wire was wound in, and the enormous carcass, weighing perhaps forty-five tons, was drawn out of the water upon the slip.

"One of the Japanese (for men of six nationalities—Chinese, Japanese, Norwegians, Newfoundlanders, Indians and Americans—are employed at these west-coast stations) scrambled up the whale's side, and balancing himself on the smooth surface by the aid of his long knife made his way forward to sever at the 'elbow' the great side fin, or flipper, 16 feet in length.

"Before the carcass was half out of the water other cutters, or 'flensers,' as they are called, had begun to make longitudinal incisions through the blubber along the breast, side and back, and from the flukes the entire length of the body to the head. The cable was then made fast to the blubber at the chin, the winch started, and the great layer of fat stripped off exactly as one would peel an orange. When the upper side had been denuded of its blubber covering, the whale was turned over by means of the 'canting winch,' and the other surface flensed in the same manner.

"The blubber is a layer of fat of varying thickness which covers the entire body of all whales, porpoises, and dolphins, and keeps the animal warm. It acts exactly as the feathers of birds or the hair of land mammals—as a non-conductor to prevent the natural heat of the body from being absorbed by the water in the one case, and the air in the other. On the great bowhead, or Greenland right whale, which lives in the intensely cold waters of the Arctic Ocean, the blubber is twelve or fourteen inches thick in some places.

"When the 'blanket pieces,' as the blubber strips are called, were torn from the carcass, they were cut into large oblong blocks and fed into a slicing machine, clipped to small bits, carried upward and dumped into enormous vats, to be boiled or 'tried out' for oil.

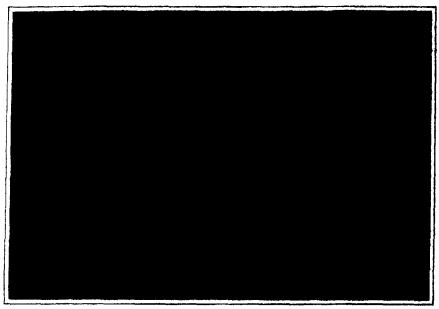
"The carcass had meanwhile been split open by chopping through the ribs of the upper side, a heavy hook was attached to the tongue bones at the throat, and the entire mass of heart, lungs, liver and intestines drawn out at once. The body was then hauled to the 'carcass platform,' at right angles to the 'flensing slip,' the flesh torn from the bones, and the skeleton disarticulated.

"Both flesh and bones were piled separately into great open vats which bordered the carcass platform, and boiled to extract the oil. The flesh was then artificially dried and sifted, thus being converted into a very fine guano, and the bones pulverized to form 'bone meal,' also a fertilizer. Even the blood, of which there are several tons in a large whale, was carefully drained from the slip into troughs, boiled, dried, and made into guano. Finally, the water in which the blubber had been tried out was converted into glue.

"The baleen, or whalebone, which alone remained to be disposed of, was thrown aside, to be cleaned and dried as opportunity offered. The baleen of all the rorquals is short, coarse and stiff, and in Europe and America has but little value. In Japan, however, it is made into many useful and beautiful things."

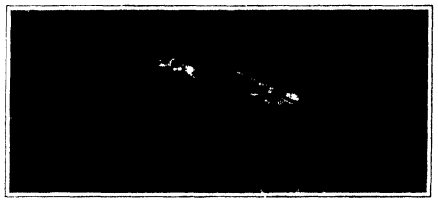
With the exception of minor details, is the method of handling whales which the Norwegians developed after years of experimenting, and which is followed in almost all other parts of the globe except Japan.

The Japanese apparently surpass all other nations in using the carcass of the whale to the utmost. Not only have they extracted the best there is in the whale and adapted them to their peculiar needs, but they have added much to their experience which whalemen of other nations would do well to recognize, Mr. Andrews believes. "Too poor to buy beef, the diet of many Japanese along the coast would include but rice, fish and vegetables, were it not for the great supply of flesh and blubber furnished by these huge water mammals. In winter the meat of the humpback whale, which is most highly esteemed, sometimes brings as much as 80 sen (15 cents) per pound; but this is unusual. Ordinarily it can be bought for 15 sen or less. But the edible portions are not only the flesh and blubber. Certain parts of the viscera are prepared for human consumption, and what remains is first tried out to extract the oil, then chopped by girls using hand knives and



The harpoon as it strikes the whale.

In addition to the rope the harpoon carries a bomb which is exploded three or four feet inside the whale and usually kills the huge animal instantly. The black cloud is the smoke from the discharge.



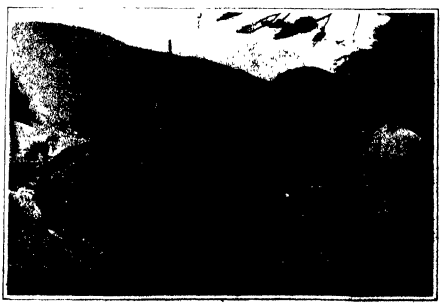
Towing the inflated whale to the factory.



The Bowles Bank

The carcasses of five humpback whales: Vancouver.

This whale is considerably smaller than the blue whale, its maximum size being 85 feet.



Head of the 60-foot sperm whale sent to the American Museum in New York: this head yielded 20 barrels of spermaceti.

Photographs by courtesy of the *National Geographic Magazine*.

dried in the sun for fertiliser. Whale meat is very coarse-grained and tastes something like venison, but has a flavor peculiarly its own.

"I have eaten it for many days in succession," says Mr. Andrews, "and found it not only palatable, but healthful. The Japanese prepare it in a variety of ways, but perhaps it is most frequently chopped finely, mixed with vegetables, and eaten raw, dressed with a brown sauce.

"In the summer, when it is impossible to ship the meat to any distance because of the heat, much of it is canned. The flesh is cooked in great kettles, and the cans made, packed and labeled at the stations. On my desk, as I write, is a tin of whale meat which I brought from Aikawa, where hundreds of pounds were packed and sent southward to be marketed at Tokyo and shipped to all parts of the empire."

Battle Practice in the American Navy as an Example of Efficiency

PROBABLY the most marvelous and valuable example of standardized operations anywhere in the world is on our American fleets in battle practice," so states Mr. Harrington Emerson, the efficiency engineer, in the *Engineering Magazine*. "The art of war has not changed as to its fundamentals since men first began to fight on land or sea. The purpose is with a stronger force to overwhelm a weaker opposing fleet—to strike first, hardest and quickest. It was Goliath's idea to pick off the Israelites one by one, and a modern pugilist could defeat a hundred men if they charged him singly, and he could down the first before the second came up. A 'Dreadnought' makes all the navies of the world without 'Dreadnoughts' obsolete, because such a battleship with its ten 12 inch guns can fire a broadside from all of them at once while steaming at 21 knots.

"Such a battleship steaming as fast as any rivals, bringing more guns into action than any rival, hitting an enemy at seven miles, could destroy the whole of an opposing fleet one by one, even as the pugilist would take the lighter weights one by one. But the horse-trotting, fire-fighting American stop-watch practice is also in the navy, and it was realized that if these big guns could be fired four times as fast, it would be very nearly the same as having four times as many guns or four times as many 'Dreadnoughts;' and also that if the skill of aim could be increased four-fold, if four shots would reach the target as compared to one in the older practice, one modern 'Arkansas' or 'Wyoming,' with twelve 12 inch guns, firing four times as fast and hitting four times as often, will, for the time being at least, be sixteen times as effective. These big guns are loaded, aimed, and fired twice in a minute. The practice drill is only half this time, and this practice drill is of two kinds. There is the physical act of loading the heavy gun, there is the more important act of pointing it. Two opposing ships are 10,000 yards apart (about six miles) steaming at 18 knots in diverging directions. The rate of change of range may be 750 yards a minute. If the range is set for every 50 yards, it must be redetermined every 4 seconds. This is impossible, but it can be determined every 30 seconds and a salvo be fired every 30 seconds. Being able to determine the range twice a minute, to fire twice a minute, the remaining part is drill in pointing or aiming, and this is done by means of much practice with models.

"To hit a target 60 feet wide and 30 feet high at 30,000 feet with a big gun, when you can cover it twice over by the point of a lead pencil at arm's length, is considerably harder than to hit a target 1 inch high at 83 feet with a small gun, but it is much better and much cheaper to fire 1,000 shots with the small gun than to fire the big gun once, and when the big gun is fired four times in practice, after training with small apparatus, it will do better than if firing 100 real shots without the model practice.

"In the battle practice I saw the first 12-inch range-finding shot, from a distance of 14,000 yards, go clean through a 30 by 60 target; and so accurate and secure was the aim of all the salvos that we calmly watched the shots splash all around the floating target only 400 yards away. The firing end was not less impressive. The team work was so perfect that the salvos from the same ship were redirected one after the other almost with the ease with which a child swings a garden hose.

"I have also watched diminutive and juvenile Igorot savages shoot dimes from a forked stick at 60 feet with bow and arrow. The Igorots show us the beginnings of offensive skill; modern American battleship target practice shows us the highest speed, accuracy, and distance yet attained, and we may not doubt that our present achievement is but a step in man's ultimate achievement.

"The improvement in the effectiveness of the different ships of the navy in the last five years is very great, and is probably the greatest improvement both in importance and magnitude that has ever been accomplished. Think of the small degree to which the steam turbine is superior to the reciprocating engine (a questionable 5 per cent), or how very little faster the best passenger trains are than the slowest of the same class (about 25 per cent). Think of the enormous expense in time and money spent in developing either steam turbines or high-speed trains, then think of the sixteen-fold increased efficiency of our battleships as compared to five years ago, an increased efficiency due to the application of the principles of efficiency—*all of them*—Ideals, Common Sense, Competent Counsel, Discipline, the Fair Deal, Reliable and Immediate Records, Schedules (of 10,000 yards), Dispatching (of big shot at the rate of ten or twelve a minute), Standardized Conditions, Standardized Operation (secured by constant and assiduous team drill), most minute Standard-Practice Instructions (as to how fifths of seconds can be saved in time), finally, a joyful and much coveted Efficiency Reward, in both honor and emolument, when the tremendous results have been accomplished. And when this appears not only in the spectacular gunnery, but also in the more prosaic but continuously important operations of firing coal; of coaling ship (the record as to this having increased from 30 tons an hour to 360 tons an hour on some of the ships for the whole cruise around the world), of the maintenance of operation of machinery on board ship without going to navy yards—these accomplishments show that high efficiency requires neither great outlay nor protracted time but only the proper intelligence, spirit and organization. The sea going form of organization is admirably adapted to apply the principles, since a gun drill, a coal drill, a recoaling drill, is but a practical and modern form of drill. The ideal is not a mere dress parade, but to hit accurately, fast, and furiously, at the greatest distance, an enemy's ship overtaken by better management throughout; and this ideal has been accomplished stop watch in hand, refining all the conditions and operations, this refinement made possible by bringing to bear all the available knowledge in the universe. This navy work is a great game not drudgery. It is pleasurable excitement and joyously hard work."

Good Roads and the Motor Truck

THE experience already accumulated with the motor vehicle has abundantly demonstrated that one necessary feature to its successful use is good roads. There are few existing types of motor vehicles capable of carrying large loads which can compete as yet with the 10 or 20 mule team on the Western plains. That there are possibilities in this direction will certainly be admitted, and some manufacturers are already working in this direction, witness the "Caterpillar" traction engine recently illustrated in these columns and the farm tractor.

In the opinion of the *Engineering News*, it must be said that the motor vehicle is at present confined to good roads. "When it strikes a soft spot or a slippery spot, it has an uncomfortable habit of digging a hole and burying itself with a promptness that would make any ground-burrowing animal known to zoology ashamed of its feeble efforts.

"An excellent exemplification of the dependence of motor trucks upon good roads is furnished by the experience of an enterprising truck manufacturer who last fall sent a 5-ton truck to make a journey from Denver to Los Angeles, loaded with 3½ tons of lumber.

"It took 68 days to make the journey of 1,519 miles from Denver to Los Angeles, an average distance of about 22 miles per day.

"The journey was made," the *Engineering News* presumes, "to demonstrate the ability of the truck to pass unscathed over the roughest and most unpromising territory. What the demonstration really showed, however, was that if the truck or any other vehicle of similar construction is to be operated at a profit, it must have reasonably decent roads to run on. Judging by the official accounts of the trip which were given out, the load of lumber was pretty well worn out during the journey through its frequent use ahead of the truck to carry it across soft spots in the road.

"Such freight hauling by motor vehicle may be good advertising but it is not good business. In fact it is extremely doubtful whether any vehicle weighing as much as four or five tons with its load can be profitably run over soft dirt roads.

"The advent of the commercial motor vehicle is interesting to highway engineers from two points of view. In the first place it will enormously increase the demand for good road construction. In the second place it will likewise enormously increase the wear and tear upon road surfaces. Perhaps this is the most important engineering problem of all those presented by the advent of the motor vehicle.

"As every engineer engaged in highway construction knows, the advent of the pleasure automobile has revolutionized our whole problem of highway construction, has practically doubled the cost per mile of permanent macadam roads and has probably much more than doubled the annual cost of maintenance. It has been hoped by the engineers who have most to do with road problems that a fairly satisfactory solution has been reached through the use of the latest and best forms of bituminous macadam involving an increased expense in construction and maintenance about as outlined above.

"If, however, as seems not only probable but certain, we are in the near future to add to our present heavy passenger automobile traffic the traffic of heavy motor trucks, carrying loads of two to eight tons and propelled at speeds reaching 20 miles an hour or higher, what sort of road surface can the engineer provide that will stand the wear, and yet not exceed the taxpayers' limit of elasticity? We shall not attempt to answer this question. We doubt whether any one is wise enough to answer it now; but it is one that will have to be answered in the near future.

"Sooner or later, the heavily burdened taxpayer is certain to raise a protest at the enormous burden imposed upon him for road maintenance. Sooner or later, conservative sentiment will awaken to the foolishness and wickedness of unloading upon posterity the burden of paying for good roads which are destined to be worn out long before posterity arrives. Sooner or later, we must place upon the owner of the automobile the burden of paying for the wear and tear which his machine produces upon the roads.

"The fool propaganda of good road enthusiasts has widely disseminated the notion that good roads are cheap to build and once built cost little to maintain; and this notion has caused a vast amount of trouble for engineers.

"It is important that the public should understand that *good roads cost money and a lot of money* to build and to maintain, and that with the advent of the commercial automobile *their cost per mile* for both construction and maintenance is likely to be materially greater in the future."

The Adventitious Arsenic in Fruit

THE use of Paris green as an insecticide on fruit trees has been pretty generally abandoned because of its solubility and the consequent injury to fruit and foliage. The substitution of arsenate of lead has been on the whole more satisfactory, although, as P. J. O'Gara points out in *Science*, a careful examination has shown that this substance is not altogether without objectionable features. In the preparation of arsenate of lead by the combination of either the *nitrate* or *acetate* of lead with *disodium* arsenate, there are formed three distinct lead arsenates in varying proportions. The ortho-arsenate, $Pb_3(AsO_4)_2$, is practically insoluble in neutral or alkaline water, and so quite harmless. But the *meta*-arsenate, ($PbHAsO_4$), is commonly very injurious; and the *pyro*-arsenate, $Pb_2As_2O_7$, may become so when the water used contains in solution chlorides, sulfates or carbonates—which means practically all common waters.

In addition to burning or spotting of leaves and fruit, varying quantities of the arsenic are absorbed. Chemical analyses showed this amount to vary with the degree of spotting. In some spotted apples the skin showed, in a 10-gramme sample, as much as 0.05 milligramme of arsenic, in a single apple there was a total of 0.3 milligramme.

The presence of arsenic in the paper used for wrapping the fruit for shipping is also a source of danger. The writer refers to one shipment of pears from the Pacific coast in which all the fruit came from one orchard and was treated exactly alike, two different kinds of paper being used. When taken from storage one half was much farther advanced in ripening than the other, and the difference corresponded to the presence of arsenic in the paper. That arsenic hastens the ripening process has been known for some time.

The writer warns fruit growers about the quantity and the composition of the arsenate of lead used in spraying, and about the brand of paper used in wrapping the fruit.

Bent by the Sun

THE towering Washington monument, solid as it is, cannot resist the heat of the sun poured on its southern side on a midsummer's day, without a slight bending of the gigantic shaft which is rendered perceptible by means of a copper wire 174 feet long, hanging in the center of the structure, and carrying a plummet suspended in a vessel of water. At noon in summer the apex of the monument 550 feet above the ground, is shifted, by expansion of the stone, a few hundredths of an inch toward the north. High winds cause perceptible motions of the plummet, and in still weather delicate vibrations of the crust of the earth, otherwise unperceived, are registered by it.

The Inventor's Department

Simple Patent Law; Patent Office News; Inventions New and Interesting

Development of Ore-handling Machinery

THE development of ore-handling machinery in connection with ore transportation on the Great Lakes is a good mechanical illustration of the doctrine of the survival of the fittest. The millions of tons of ore accumulating in the



George W. Hulett, who has introduced a number of important innovations in machinery for handling materials.

Lake Superior region have to be transported to their lake destination during a period of not to exceed eight months in each year. Here, if anywhere, time has been the "essence of the contract." One type of apparatus has replaced another almost as soon as its mechanical and time-saving advantages have become apparent.

Every development in ore-handling machinery has been based on two ideas, namely, that of increasing the speed with which the ore is handled, and that of reducing the cost. The work divides itself naturally into two distinct operations, the loading and the unloading. The problem of loading the ore into the boats has been a simple one—gravity suggests an obvious solution, and some form of elevated bin and chute is everywhere used. Unloading, however, has always been a more difficult proposition, and has furnished a fertile field for the exercise of the inventive faculty. It is the object of this article to touch briefly upon a few of the types of devices which have been used from time to time for this purpose, and to conclude with a short description of the two leading types of machines now in use.

Originally the ore was shoveled into a bucket or tub, which was hoisted and swung around by an ordinary crane. The bucket was dumped into a traveling lorry or car located on an elevated track, and when the car was filled, it was taken to the stock pile and dumped. In a few years the single crane and bucket gave way to a battery or set of cranes all operated by a common hoisting machine. Crude and uneconomical as this apparatus is, it is still in use to a limited extent.

About 1880 Alexander E. Brown of Cleveland, O., and others, brought forth the first examples of the now well-known "unloading bridges." The prime advantage of the unloading bridge, in its early form, was that by it ore could be distributed over a large area. It also dispensed with the lorries or cars used in the previous construction.

The first unloading bridge consisted, essentially, of two towers or piers traveling on tracks laid parallel with the docks, a cableway joining the towers; an apron or boom pivoted to the front tower and projecting over the water, and a bucket-supporting carriage or trolley traveling on the cableway. The bucket was hoisted and its travel controlled by means of a cable or cables which led to a hoisting machine located in the rear tower.

Within a few years the cableways were generally replaced by rigid trussed trackways. These trackways usually extend beyond the rear tower to afford a larger travel of the bucket. However, the cableways are still used to a limited extent in places where the installation is to be used for a short time only.

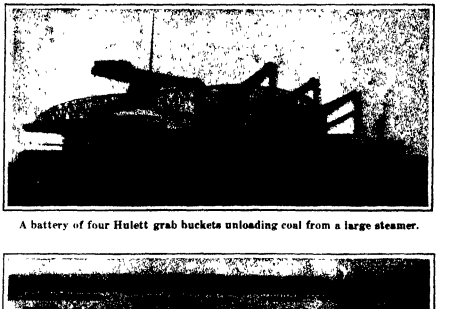
It is desirable to so arrange the bridge that it may be slewed through an angle of fifteen or twenty degrees with respect to the track. Special pivots, allowing for both vertical and horizontal swinging motion, are therefore provided between the trackway and each of the supporting towers, and the bridge is propelled along the tracks by separate independently operable motors, so that either tower may be moved without moving the other.

It is also desirable that the apron or boom may be movable to and from working position without interfering with the rigging of the boat. This has been accomplished principally in two ways. First, by means of a telescopic track-end which may be projected or retracted horizontally, and, second, by providing the boom with rollers at its inner end, which rollers travel up and down a vertical trackway on the front tower, the outer end at the same time being supported by guys. This arrangement causes the outer end of the boom to be projected and retracted along a line that is nearly horizontal.

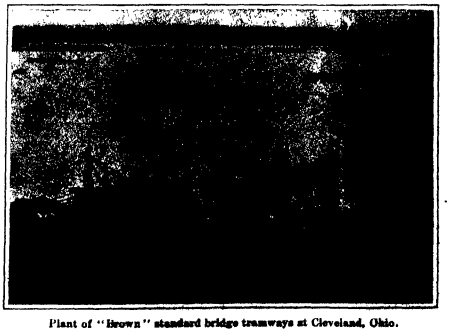
In the bridges recently constructed, the hoisting drums are mounted on the traveling carriage or trolley. This carriage also supports an operator's cab from which point all motions of the unloading bridge are controlled by a master controller. The special advantages of so mounting the drums and cab are that it avoids the use of long traversing cables, and places the operator in a position from which he can see and accurately direct all movements of the bucket.

The usual length of the unloading bridge is from 180 feet to 250 feet, but bridges are in use in which the track length exceeds 500 feet. Those at the Indiana Steel Company's plant at Gary, Ind., are 495 feet long, and the towers are spaced 187 feet from center to center. The usual height of the track above the yard is about 60 feet. The power used to operate the Gary bridges is as follows. To open and close the bucket, four 80 horse-power motors, to traverse the trolley, four 40 horse-power motors; and to move the bridge, four 30 horse-power motors.

The type of device by which the bucket has been hoisted and transported is one invention, the particular form of bucket, another, and they have not developed hand in hand. During the life of the crane-and bucket unloader and for several years after the advent of the unloading bridge, the buckets in use comprised the combination of three elements. The bucket body, the supporting bail, which was pivoted to the bucket body at a point below its center of gravity when filled, and a latch connecting the bail and bucket body. When the latch was released the bucket was reversed and dumped by the weight of the load. The great disadvantage of this type of bucket is that it is not self-filling at least not when used with ore. Probably the most arduous and man-killing work connected with the ore-handling industry is the shoveling of the ore into the buckets. It is slow, dangerous and costly. This condition led to the invention and development of the grab or clam-shell bucket, which may be said to have been one of the most important steps in the whole ore-unloading art.

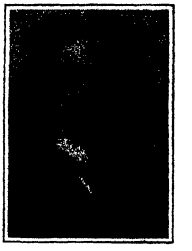


A battery of four Hulett grab buckets unloading coal from a large steamer.



Plant of "Brown" standard bridge tramways at Cleveland, Ohio.

This bucket, in its simplest form, comprises, as is generally known, two co-operating halves or jaws pivoted together, and a means for opening and closing them. The means employed may be a drum and two chains or cables, in which instance the drum is mounted on the



A. E. Brown, the originator of the "unloading bridge."

pivot, or on a frame supporting the pivot, with a chain or cable connected to each of the bucket-halves. In another type toggle levers are substituted for the drum and chains. The bucket is usually supported by two cables. When suspended by one of the cables the jaws are held open by the weight of the bucket itself; when supported by the other cable they are automatically closed. In the operation of the grab bucket it is held open and allowed to drop jaws-down, which causes it to become partially imbedded in the ore. The other cable is next hauled in, the result being that the jaws are closed. The bucket is afterward hoisted. Upon reaching the dumping point, it is again suspended by the opening cable, and the material is discharged.

The capacity of the clam-shell used in unloading bridges varies from 5 to 15 tons. Ordinarily it does not exceed 7½ tons. It is said that bridges equipped with 5-ton buckets will unload on an average about 200 or 250 tons per hour. The buckets are designed to make from 60 to 70 trips per hour, and consequently, it is not unusual to handle 350 tons per hour during the first part of the unloading of a ship.

The cost of operating these bridges, considering also interest and depreciation of plant, is said to be about five cents per ton of ore unloaded.

The clam-shell unloader, however, has this disadvantage, namely, there is no weight, other than that of the bucket itself, to force it into the material. The bucket also swings to an undesirable extent. To overcome these defects, a later type of unloading machine—that invented by Mr. George W. Hulett of Cleveland, O. was designed.

This machine comprises the following elements: A gantry bridge traveling on tracks laid parallel with the dock; a carriage traveling to and from the dock-front on girders which connect the legs of the gantry bridge; a pivoted walking beam supported by the carriage; a vertically extending leg pivoted to the end of the walking beam; a link or equalizer pivoted to the carriage and to the leg and co-operating with the walking beam to cause a parallel motion of the leg; and a grab bucket connected rigidly to the lower end of the leg. The leg may be

rotated by a cable and bull-wheel to extend the bucket in any direction.

In operating this machine the whole device is propelled along the track until it is opposite the hatch from which ore is to be taken; the carriage is run out on the gantry bridge until it is over the ore, after which the bucket-leg is lowered, it being brought positively to loading position by the combined action of the walking beam and the connecting link; the bucket is then closed about the ore, the motion of the walking beam reversed, the carriage backed, and the bucket dumped.



The "Brown" grab-bucket.

Since the moving parts are very heavy —the whole machine weighing about 460 tons where a bucket having a capacity of 10 tons is used—it is essential that the movement be reduced to the lowest possible limit. For this purpose and in order to save time, the gantry bridge is provided with a second pair of tracks, upon which a traveling hopper is supported. These tracks are extended as a cantilever at the rear of the bridge. The bridge itself straddles four ordinary railroad tracks. Consequently the hopper may be dumped into a car on any one of these tracks or run out on the cantilever extension and there discharged into a stock pile.

The control of the various motions involved is an important consideration. One operator rides in the bucket-leg close to the bucket, and has control of the hoisting, lowering and rotation of the leg, and the opening and closing movements of the bucket. Another operator directs the movement of the carriage, of the hopper, and also of the machine along the dock. The controllers, proper, for all these motions, are located near the respective motors, and are in turn controlled by small drum controllers located at the operator's stations.

The following data are given concerning the power used by the Hulett unloaders at Gary, Ind.: To open and close the bucket, 80 horse-power; for operating the walking beam, 150 horse-power; for moving the carriage, 50 horse-power; and for operating the hopper and propelling the whole machine along the track, 75 horse-power; total, 355 horse-power.

When equipped with 10-ton buckets (the usual size), each machine frequently unloads 500 tons per hour, making the capacity of each unit about 500,000 tons per season, working days only. Four steam-operated machines at Conneaut, O., have averaged 403 tons per hour on a 7,000-ton boat, and the maximum taken out by a single machine in an hour was 631 tons.

Don'ts for Air-brake Inventors*

DON'T forget that successful invention is not a pastime nor a subliminal uprush, but an evolution from long experience, painstaking observation, careful analysis, intimate familiarity with the varying requirements and local conditions in all parts of the country, thorough knowledge of mechanics and the laws of nature (not the least important of which are embodied in the M C B rules of interchange and the rulings of the Interstate Commerce Commission), a severe disregard of non-essentials and of repeated failures and an unfailing persistence, born of optimism, the courage of proven conviction, and hard, common sense.

Don't confuse invention and financiering. To invent is not synonymous with "to get rich quick."

Don't assume a parental attitude toward an invention. Fatherly sensitiveness and solicitude only add a sting to failure, while real merit will need only the backing of cold, hard facts to substantiate its claims.

Don't be satisfied with yourself or your first or even last idea of a device. Look for the defects, not the merits in any design you propose to patent. The latter will always take care of themselves. An apparent success, however, is oftentimes more fatal than flat failure. The latter at least tells the truth and usually teaches a valuable lesson, the former raises false hopes and obscures the truth and results in a corresponding greater failure when the final reckoning does come.

Don't forget that there are always two sides to every question, especially in the case of a mechanical device. None are so bad as not to have some good points. On the other hand, the merits of a device may be many and important, and yet its patent value worthless on account of non-interchangeability, too great refinement, previous patents covering the same idea, and so on.

Don't expect to get something for nothing. Whenever such appears to be possible it will surely develop that the net gain is worth exactly the price paid, namely, nothing. Stored energy can be made to perform useful work only by a transformation from a higher to a lower level, by a progression from the concentrated to the diffused, never in the reverse order. The process of converting the energy in a pound of coal into available form as live steam is on a descending scale, never at 100 per cent efficiency nor anywhere near it. Again the conversion of the energy of steam into available drawbar pull at the tender is attended by still further losses. These examples are but typical of every process by which mechanical work is performed. No mechanical system can be operated at 100 per cent efficiency; at best it only approximates this figure under the most favorable conditions of the laboratory.

Don't mistake "possibility" for "practicability." Many things are possible, but only a few are practicable.

Don't think because a really practicable device can be designed to perform some function, that it deserves to be universally adopted. To deserve attention this function must be distinctly useful and more, it must be definitely and unqualifiedly on the side of increased safety or economy of operation.

Don't attempt to find a remedy for a known defect by getting around the effect, but first discover the cause and overcome that.

Don't mistake the troubles which come from careless and improper handling or laxity in inspection and maintenance for inherent defects in the apparatus, these troubles require betterment in instruction or maintenance, rather than improvement in design.

Don't expect to find road and laboratory conditions the same. They are not.

Don't be surprised if a device which works perfectly (?) on a test rack proves unmanageable in a service test. Dirt, abuse, misuse, neglect, water, frost, heat, over-lubrication—all are in favor of such a difference.

Don't overlook existing apparatus and conditions.

Don't forget that in the air-brake any failure in function of any part must be in the direction of safety—not of danger. In other words, a failure must cause the brakes to apply—not to release or prevent a brake application when one is attempted.

Don't think because a device will operate satisfactorily in itself that it will meet with instant and unqualified success. For example, the electro-pneumatic brake is an ideal system for long train service, and was so acknowledged in the official report of the M C B Burlington brake trials ("The best type of brake for long freight trains is one operated by air and in which the valves are actuated by electricity.") But it is not and probably will not for some time be adopted in steam-road freight service on account of fundamental mechanical, practical and economic considerations, the force of which is patent to anyone familiar with what such a change would involve.

Don't forget that the millions of dollars of capital already invested in existing equipment prohibit the introduction of any device which will not work in perfect harmony with the apparatus now in use under every conceivable condition of service.

Don't allow mechanical ingenuity to obscure the limitations imposed by the laws of pneumatics and mechanics or considerations of practicability and economy.

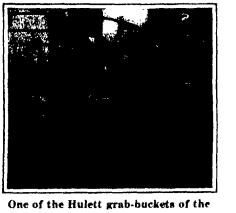
Don't think that an air-brake device stands alone. Not only is it affected by surrounding conditions and other devices with which it is associated, but it in turn also affects to a greater or less degree all other members of the system in which it operates.

Don't place too great faith in the results obtained with a single device or under a single fixed set of conditions. Railroad conditions demand that air-brake appliances work as well on a 50 or 100 car train as on a single car and under the most unfavorable as well as favorable conditions. Many devices and systems will work marvelously well alone or in short trains or under favorable laboratory conditions and yet be totally unfit for long-train or mixed service or subject to fatal disarrangement or entire failure when exposed to neglect, extremes of weather or careless handling.

Don't neglect friction. Usually there is more friction than can be conveniently provided for at every point in the brake apparatus, except where it is most needed, viz., between the brake shoe and wheel. Here there is seldom enough.

Don't assume that air can move instantly. Air has inertia and requires time to change from a state of rest to motion.

Don't consider air as being without friction. The friction between a moving column of air and the walls of the pipe



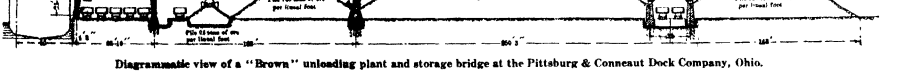
One of the Hulett grab-buckets of the battery shown unloading a steamer.

or passageway in which it moves may be considerable, and productive of unexpected and disconcerting results when not properly allowed for. For example, it has already been shown that with the triple valves cut out the brake pipe may be left wide open at the front end of a 100-car train and instead of an instantaneous drop in pressure throughout the length of the pipe the last quarter of the train remains at its original pressure, without perceptible drop, for fully twelve seconds. This is the result of the combined effect of inertia and friction.

Don't spend time, money, or energy upon devices which depend for their proper operation upon different rates of rise of brake-pipe pressure. Much of the first 25 or 30 cars the difference between a high or low excess pressure or the use of release or running positions of the brake valve handle can barely be detected by the most delicate recording apparatus.

Don't overlook the variability of the human equation. As long as there is any possibility of mishandling or wrong manipulation, it will surely be found, for there are a thousand ways in which a thing may be wrong, done and but one right way. It is for this reason that "fool proofness" takes high rank among the prime essentials of all air-brake devices.

Don't overlook the fact that simplicity, interchangeability, fool proofness and low first and maintenance cost often have more to do with the success of a device



Diagrammatic view of a "Brown" unloading plant and storage bridge at the Pittsburg & Conneaut Dock Company, Ohio.

than ingenuity of design or merits of construction.

Don't fail to consider the economic features of any device which is to be proposed for patent. Safety and protective features being equal a net gain in dollars and cents must be shown over and above the rating of the apparatus to be displaced or added to before any excuse can be offered for even considering a change.

Don't consider the ordinary materials of manufacture indestructible. The results of wear must be foreseen and provided for if the apparatus is to be practicable.

Don't expect to accomplish results by

* Abstracted from the Third Annual Report of the Block Signal and Train Control Board to the Interstate Commerce Commission.

means of large supply reservoirs located at different points in the train to be connected into the brake pipe to assist in releasing and recharging The danger characteristic of all such schemes, viz, an undesired release of the brakes or in ability to apply them when an application is all mpted is inseparable from any system in which the derangement or failure of the mechanism controlling the connection between the brake pipe and stored volume permits the brake-pipe pressure to be increased when not intended

Don't forget that cars must be handled in yards and terminals without the brakes being coupled up and without air in the brake systems

Don't lose sight of the fundamental functions of the brake system as a whole No device, regardless of how perfect its individual design, construction or operation may be, can be tolerated which carries with it the possibility of interference with the normal operation of the brake as a whole

Don't attempt to eliminate what appears to be a defect without considering carefully what effect the means adopted will have on other functions of the brake as a whole While the desired improvement may be possible it may be at the expense of trouble in other directions of such greater moment as to prohibit the change proposed

Don't try to cure apparent defects of design or function by the use of additional devices subject to the same or worse objectionable features The cure is bound to be worse than the disease Usually it can be overcome in a better manner than by the use of additional devices

Don't expect the proposal of a novel brake system for steam road service involving the use of two brake pipes to be received with favor by the railroads If American railroad practice would permit of the use of an extra brake pipe, with hose connections between cars, some one of the hundreds of schemes of this sort patented from time to time would no doubt have been adopted long ago The fact that on y one brake pipe is tolerated in modern American practice, when considered along with the self-evident and sound reasons why this is the case, should be sufficient to effectually discourage further efforts in this direction The differences between steam and electric or European service conditions are a sufficient explanation why two, or even more, air pipes have been successfully used in the latter case

Don't forget that mechanical locking devices intended to hold the brakes applied while descending grades depend for their proper action upon such close adjustment and sensitiveness of operation and involve such a multiplication of parts that the fundamental requirement of a brake device, viz, absolute reliability is lacking at the outset

Don't permit any device to become associated with the brake pipe in such a way that its failure to act as intended can, by any possible chance, prevent an application of the brakes or cause a loss of the brakes if applied

Don't fail to recognize the brake pipe as the one and only central nerve of the air brake system and to treat it accordingly It is not to be furnished with attachments except under stress of positive necessity and only then after provision has been made so that any failure on any part to perform its function will be on the side of safety and not danger Put yourself in the place of the submarine diver some fathoms be ow the surface of the sea and consider what your views would be upon a proposal to ingraft various accesso devices along the air tube whose integrity spells life to you at that moment Much the same feeling animates those responsible for the insurance of traffic stability and the safety of human lives with regard to the preservation of the functions of the brake pipe.

Don't mistake convenience for necessity Where the necessities already tax the capacity of the system as a whole to the utmost, as is the case with the air-brake, mere convenience without demonstrable economy, either in maintenance or service operation, is not to be considered

Don't expect to provide a satisfactory safeguard against rare contingencies by means of apparatus requiring careful adjustment, frequent cleaning, and so on, to insure its being always in proper working order The usual resu t in such cases is that the protective device becomes inoperative through neglect due to fancied security and fails to work at the critical moment

Don't think that because an idea is new to you it is new to the air-brake art Most of the simple and practicable methods of accomplishing desirable results have been covered by patents for many years The odds against a simple and practicable device such as railroads want and are willing to accept, being new are therefore great As any working device is usually made up of a combination of a number of simple princip es it follows that before even taking out a patent, surely before becoming enthusiastic over the va ue of an idea, cold-blooded skepticism will save many dollars and much disappointment later on The very small cost of a search for previous patents related to the same idea will save valuable time and money, and in most cases convince the embryo inventor that he is far from being the first in the fie'd That this advice is not mere personal opinion or a desire to quench ambition's spark, but is the simple, unvarnished, but in the end merciful truth of the matter, will be acknowledged by all who have made a study of the art It is, moreover, precisely the basis upon which all manufacturing organizations conduct their development of new apparatus Nothing is left for chance or taken for granted All that has been done in their line is classified and studied minute y Thousands of dollars are spent in sifting out the old from the really new and patentable If this is sound business policy for the large concern, with unlimited resources, how much more wise and prudent for the individual of limited means, who can not afford to spend time and money without reasonable assurance of profit

In a word inventing is an art of the highest type, requiring peculiar genius, training and experience, while the capacity for appreciating or foreseeing the real value of a patent is an entirely different thing, requiring quite a different sort of skil l and education Consequently even the best inventors are rarely, if ever, capable of accurately gaging the value of their own inventions from a purely patent standpoint

Protecting an Undeveloped Patent

AN inventor is frequently confronted with the problem of protecting an invention which he has conceived, pending his perfection and completion of the improvement and at times he misses the apparent protection of a public record which at one time he was able to secure by the filing of a caveat. When an inventor conceives an invention, which is not the idea that some such improvement might be made in some way or other, for conception of an invention includes a thought of the means by which the invention may be carried out in practical form when he so conceives of an invention, he should proceed with a l the diligence at his command to complete the invention into form for practical use and should use it successfully in the presence of reliable witnesses who can be depended on to testify not only truthfully, but accurately as well to the successful operation and construction of the device Pending the completion of his invention, the inventor should preserve all sketches, drawings, models and descriptions, made from time to time, with the dates of making and with the signatures of reliable witnesses, with the dates of signing and shou'd preserve all records, bills for materials and the like, so that they may be available for evidence should a contest ever occur, bearing in mind that the better his preparation for a contest, the less likely he is to experience one.

Notes for Inventors

Artificial Rain.—A method of producing artificial rain for farmers has been invented by Mr Emilio Olsson, of Buenos Ayres, and has been copied in France and Germany Mr Olsson is now in this country for the purpose of introducing his invention His system has been used with great success on an experimental farm near Buenos Ayres One of the Olsson installations is in successful use at the Peluffo Gardens in the Calle Rivadavia, and consists of three lengths of one-inch piping, two lengths being placed at an altitude of five meters, and the third at a height of 3½ meters, in accordance with the height of the plants watered Each length of piping is fitted with two jets of four spouts each, the effect produced is exactly that of a shower of rain Mr Olsson has devised a method whereby the water can be charged electrically, with the result that not only are crops greatly improved, but that insect pests are destroyed

A New Indicator for Ships.—An English newspaper account tells of a newly invented "direction and rotation indicator" for steamships which is to be placed in the chart room and bridge and enables the navigator to see at a glance the speed and direction of the engines and number or revolutions per minute When ordering "ahead" or "astern" at any speed the indicator instantly tells whether the order is being executed

Tales of an Assistant Examiner.—A prominent New York attorney tells of an experience with an assistant examiner of the Patent Office, with whom, in an interview, he found it difficult to come to any definite conclusion about anything involved in the discussion Finally, almost in despair, the attorney said "Now," addressing the examiner by his title, "will you agree with me that this claim is either allowable or is not allowable?" and after due consideration the official gave this guarded reply "That the claim is allowable or is not allowable Well, for the sake of argument, I will agree that the claim is allowable or is not allowable" If all the stories that have been told of this assistant examiner, who is as generous and bighearted as he is peculiar, were gathered in a volume, the result would be some interesting and amusing reading

Reciprocity in the Patent Office.—Reciprocity, or retaliation if you please, is found in the Patent Office rules, in the provision that any foreign patent attorney, not a resident of the United States, may be registered as entitled to represent as attorney applicants before the Patent Office if the country of which said patent attorney is a citizen grants the same reciprocal rights to citizens of the United States, and no foreign patent attorney will be recognized in any application filed after June 30th, 1908, unless his country grants reciprocal rights to our attorneys As a matter of fact, it is thought that only three foreign nations, namely, Canada, Mexico and New Zealand, extend the privilege to patent attorneys of the United States, so that the number of foreign attorneys entitled to registration here is very limited

The Frequency of Automobile Fires.—Is there not needed a fire extinguisher especially adapted to extinguish fires accompanied by the burning of gasoline or resultant gases? The extinguisher should be adapted to be carried on the machine, where it can be detached and brought into play by a by-stander even if the machine has turned turtle, and the extinguisher should be so distinctive in structure or appearance or both, as to be quickly identified and selected from the other equipment of the machine. Should the appalling loss of life from this cause continue, it would not be surprising to find the public urging the enactment of laws requiring as a life saving means, that machines be supplied with suitable or standard extinguishers as a pre-requisite to the issuance of the license to the operator

A Long-delayed Patent.—Geo. Francis Myers, of Columbus, Ohio, is the patentee, No 995,550, of a flying machine which has the appearance of the lower half of a sphere. It is made with a number of circular aeroplanes arranged one above the other and gradually increasing in size toward the top and a car is provided at the bottom and has a propeller for moving the machine laterally. The application on which this patent issued was filed in 1904 and is a continuation of an application filed January 29th, 1897, over fourteen years ago. We wonder what will be gained by the delay, and so will all who know something of the aerodynamics.

Pumping Snow.—Snow disposal is now considered a big problem and Cadwallader Evans, Jr., of Pittsburg, has patented, No. 995,446, a method of removing snow from city streets by which he gathers the snow in quantities, then he agitates the co'lected snow at the same time adding water, the mixture is then heated, bringing it to a condition in which it can be handled by pumps and he then pumps it to some suitable disposal point.

The Inventor and the Milliner.—To provide for quickly producing hats of different styles is the purpose of a patent, No 995,990, to David Stern of New York, who provides a brim and crown and then fits a supplemental crown around the brim crown This mounting of a separate crown around the main crown enables the use of different supplemental crowns to secure the desired effect and the two crowns can be trimmed separately which is a great convenience to the milliners

A New Way of Operating a Vacuum Cleaner.—Operating a vacuum cleaner by the force of water discharged from an ordinary water service spigot is contemplated in a patent, No 995,969, to Beecher W Junk of Toledo, Ohio, who provides a main pipe to couple to the spigot and an air pipe leading to the main pipe, the ordinary vacuum cleaning tool being connected to the air pipe. He has a spiral sleeve in the water pipe which causes the water to have a whirling motion and produces an air suction up through the air pipe or hose He thus produces a device which can be attached to a water spigot and cause the water to produce a vacuum.

Take Up Your Bed and Climb.—An article of furniture useful as a bed by night and a ladder by day is the subject of patent No 995,430 to Jerome Arsenault and Chas Larrivee of St. Flavie, Quebec, Canada. They make a bed whose side rails and end rails have bars and rungs between them so the bars when the bedstead is taken down, can be handily used as ladders.

Distilling by Induced Electric Currents.—A patent, No 994,022, has been issued to the assignor of Robert J. McNitt of Niagara Falls, N. Y., for a process of distilling substances which cannot be distilled by the application of external heat on account of the destructive effect of such heat upon the wal's of the distilling vessels, the process consisting in generating the required degree of heat by induced electric currents. The process appears to be especially designed for distilling alkali metals from their alloys.

Milling Grain in a New Way.—Harry M Blinn of Baltimore, Maryland, has secured a patent, No. 995,819, for a milling process in which grain is pulverised in its entirety to reduce it to an impalpa-

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Inquiry No. 9343.—Wanted, address of maker of [illegible] for [illegible].

Inquiry No. 9344.—Wanted, address of manufacturer [illegible] rubbers, cushions, and rubber for [illegible] tires.

Inquiry No. 9345.—Wanted, addresses of parties having raw materials or minerals containing potash in [illegible].

Inquiry No. 9347.—Wanted, to buy a Parcelex [illegible].

Inquiry No. 9348.—Wanted, the name and address of manufacturers of road rebuilt and pan holders, such as are used [illegible].

Inquiry No. 9349.—Wanted, by a patent solicitor, a [illegible] which could be operated on a [illegible] and which could be reversed.

Inquiry No. 9350.—Wanted, the name and address of parties who can supply [illegible] for [illegible].

bie powder and branny flakes are coated with the powder thus formed, the product being a flour middlings in which is incorporated a portion of impalpable cereal powder which coats the bran in the middlings.

Driving a Moving Picture Film Frictionally.—A patent, No. 994,042, has been issued to the American Moving Picture Machine Company of New York for a film actuating mechanism including means for driving a film by frictional contact with the edges thereof, the mechanism employed including a rotatable member which is arranged frictionally to engage with the edge of the film.

Wanted: A Rivet-heating Machine.—There is considerable inventive activity along the line of pneumatic riveting machines universally used in the erection of structural steel work. There does not appear however, to be any attempt to displace the picturesque blacksmith with his portable forge high aloft, who, with unerring aim, tosses the red hot rivets into the nail keg held by the riveter, but he will pass also when some enterprising inventor devises some means of heating the rivets at the very place where they are applied (electrical heating, possibly), and it is not too much to believe that they may be brought to a riveting heat in a suitable heater and fed one by one directly to the holes formed to receive them.

A New Vacuum-cleaner.—A patent, No. 993,343, has recently been issued to P. D. Brewster of East Orange, New Jersey, for a vacuum dust collector having a pipe to carry the air and dust and a water tank, together with means for introducing water from the tank into the dust pipe together with means for producing the vacuum and separate means for drawing the water and mud from the dust pipe and delivering it into the water tank.

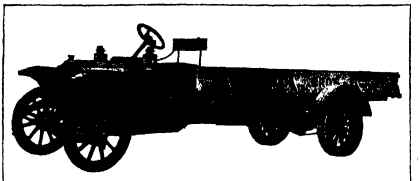
An Extensible Round-top Table.—Charles W. Munz of Detroit, Michigan, has secured a patent, No. 993,539, for a round-top table which can be extended. The table includes in connection with the permanent top a circumferential series of leaves for enlarging the said top in the same plane and supporting means for the extension leaves.

New Railway Truck Side Frames.—A series of patents, numbered 993,575 to 993,578, inclusive, have been issued to Edson C. Covert of New Kensington, Pa., for truck side frames for cars including, in most of the patents, the journal box in its connection with the members of the side frame, such journal box being integrally secured in some instances and removably weld-secured in another instance.

Crape and the Inventor.—A device for holding crape to a door is covered in the patent, No. 995,472, to Frank and Lambert of New York as assignees of Harry T. Loomis, also of New York. The holder is made with a back bar to be attached to the door. This back bar has forwardly projecting teeth to bite into the crape and a spiral spring is connected at one end of the back bar and extends over the crape to press it against the teeth of the back bar and hooks at its other end to the back bar.

Another Patent Dedicated to the Public.—Mr. Alonzo D. Melvin of the Bureau of Animal Industry at Washington has just obtained a patent, No. 986,025, which he has formally dedicated to the public. The patent is for a stamp for marking meat. The stamp has a rubber head carrying the inscription and provided with a flexible rubber shank made in one piece with the head and held in a socket in the end of a handle.

Why Not an Earth Tamping Machine?—Recently in passing a number of laborers ramming down the earth in a ditch which was being filled, it occurred to the writer why some machine had not been produced which could be managed by one man and operated to ram in the earth



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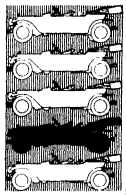
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just as it was being done by the gang of laborers Now that gasoline motors are so adaptable, the machine could be kept ready for instant use, could be supplied with rammers limited in number only by the size of the framework and the capacity of the engine, and the engine could be utilized to move the machine from place to place as well as to operate the rammers Of course, many problems would have to be solved, but they would doubtless yield to the skill of an ingenious inventor

General Otis and the Patent Office.—General Harrison Gray Otis, who has gained increased notoriety through the blowing up of his newspaper plant in Los Angeles, and his controversy with organized labor, was at one time an official of the Patent Office at Washington, where he was chief of the corps of proof readers prior to the organization of the Issue and Gazette Division. General Otis was appointed to the Patent Office from Marietta, O., in May, 1871, and resigned January 31st, 1876, thus serving in the Patent Office a little less than five years

An Implement for Cleaning Ceilings.—The cleaning and scrubbing of ceilings is frequently a difficult matter and an implement has been patented, No 994,204, by T A Schoenlau of St Louis, especially designed for the purpose It has a funnel shape body to put up against the ceiling in which are provided rotating brushes to which a cleansing fluid is delivered to cleanse the ceiling

A New Continuous Current Arc Lamp.—Inventions in arc lamps are nearly always interesting and along this line Max Korting of Leutzch, near Leipzig, Germany, assignor, in a patent, No 994,261, presents a continuous current arc lamp which has a number of depositing surfaces supplied with electric potential, one of the surfaces being connected with one terminal of the lamp and one with the other terminal

A Mechanical Sparring Partner.—Exercising devices are quite popular and a patent, No 992,862, was issued last year for such a device in the form of a dummy or figure representing a person of normal size and mounted upon a freely rocking weighted base permitting it to swing in all directions. The body portion of the figure is suitably stuffed or inflated and the person exercising may strike it with his bare fists or may use gloves and the figure, when struck, will be caused to rock rapidly on its weighted base simulating the action of a punching bag The weighting of the base causes the quick return of the figure after it has been struck and as the figure may move freely over the floor when struck, the user secures considerable practice in foot work as well as in striking. This sparring partner suggests the possibility of a wrestling partner and no reason is seen why a wrestling partner should not be invented which could in many ways operate to exercise the person desiring practice on the mat

Wanted: An Automatic Grain-shocker.—In an article by W. J Brandon, in the *American Thresherman*, the statement is made that in the grain fields there is an opening for an automatic grain-shocker, which can be sold at a reasonable price Such a machine would be another great aid to increased efficiency "No machine," he states, "has yet been put upon the market that shocks the grain successfully"

The Ozone Generator.—In the SCIENTIFIC AMERICAN of May 27th attention was called to the suggested necessity of an ozone generator in commercial form, adapted for what might be termed popular use Since then, the attention of the writer has been called to the so-called ozonator made by the General Electric Company and fully described in the *General Electric Review* of June, 1911, in an article which includes the physical and chemical properties of ozone and a description and illustration of the device. This is said to be the practical result of years of experimentation. The device includes means for providing ozone when the current is applied a blower for forcing air through the ozone chamber and diffusing the ozone throughout the room, suitable connections insuring the running of the blower at all times when ozone is being produced Connections for the current and for the switches for controlling the same are provided and the apparatus presents a neat, compact and business-like appearance

Theory vs. Practice in Invention.—B was the inventor of a new machine for stoning peaches and M was a successful inventor who had made good inventions and had been able to market the same in a way to make a pronounced commercial success B's peach stoner was a marked departure from anything that had gone before and he was proud of the practical evidence of his originality. Appreciating M's experience along the patent line, B asked him his opinion of his new invention After careful examination M said: "Your machine is all wrong in principle, but," he added, "I made a machine for taking the stones out of peaches that was all right in principle My machine which was all right in principle would not work in practice Possibly your machine which is all wrong in principle will work all right in practice" I never learned whether B's machine was a practical success.

Wanted: A Humane Dog-muzzle.—The dog muzzling time is now at hand No one questions the discomfort, if not the cruelty, of many of the muzzles now in use Have you ever thought of the tremendous market that is ready and waiting for some one who can devise a simple, inexpensive, efficient and essentially humane muzzle? Such a muzzle would be welcomed by the dog owners and, since it could be worn without annoying the animals, would avoid the dangers resulting from the removal of the muzzle, especially after nightfall, when the guardians of the law are not so likely to observe conditions

Legal Notes

Establishment of Trade-mark Rights.—What is sufficient initial use of a trade-mark to establish trade-mark rights is frequently questioned The Court of Appeals of the District of Columbia in the recent case, decided April 3rd, 1911, of Bratenbach and F H Strong Company vs Rosenberg, says

"Every trade-mark must have a beginning, and it would be unreasonable and unjust to say that it must be general, and the article widely known before the trade-mark in the name affixed to it, and indicating its origin, can be acquired"

In this case, the Court of Appeals quoted with approval an opinion of the Circuit Court of Appeals of the Seventh Circuit in Malzkaffee Fabriken vs. Kneipp Med. Co., 82 Fed Rep., 321, as follows:

"It is enough, we think, if the article with the adopted brand upon it, is actually a vendible article in the market, with the intent of the proprietor to continue its production and sale It is not essential that its use has been long continued, or that the article should be widely known, or should have attained great reputation The wrong done by piracy of the trade-mark, is the same in such case as in that of an article of high and general reputation and of long continued use. The difference is but one of degree and in the quantum of injury A proprietor is entitled to protection from the time of commencing the use of the trade-mark."

The Ownership of a Trade-mark Not Originated by the Owner.—In the case of Nestle & Anglo-Swiss Condensed Milk Co vs. Walter Baker & Co., Limited, the Court of Appeals of the District of Columbia on April 7th, 1911, reversed the decision of the Commissioner of Patents and held that where the opposer was not the originator of the trade-mark consisting of a waitress in Quaker or Puritan costume carrying a tray, such opposer has no right to exclude every one else from using the representation of a woman as a trade-mark upon goods similar to that manufactured by it.

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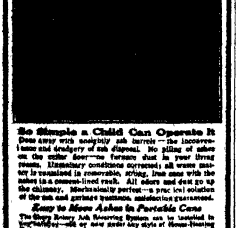
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Pertaining to Apparel.

FLEXIBLE CONNECTION.—J. H. O'BRIEN, Illion, N. Y. An object of this invention is to provide a device in which a plurality of members are movable relatively to each other against the tension of a spring, the members having attached thereto flexible connections, for supporting in various manners, with a yielding tension due to the resilience of the spring.

Electrical Devices.

TELESCOPIC MAST FOR WIRELESS TELEGRAPHY, SIGNALS, AND SIMILAR USES.—A. F. JUILLAC, 25 Rue de Meaux, Paris, France. In extending the folded mast the sleeve is brought into position to allow pawls to engage the uppermost tube ferrules. The crank shaft moves the sleeve upward on the standard and elevates the said tube, which when at its highest point, the top of a second tube is clamped on its bottom by means of a rod. The sleeve is then lowered and engaged with the second tube, and when again moved upwardly, both tubes are lifted. When the second tube has reached its highest, the top of a third tube is clamped on the bottom of the second and the sleeve lowered and engaged with the bottom of the third tube. This is repeated until the mast is extended. Means provide for folding the mast.

Of Interest to Farmers.

MANURE LOADER.—A. S. STORM, Clear Lake, S. D. This invention provides a device which forms a platform or carrier for the material to be handled as the same is moved in the first instance, provides a runway or inclined rear bed to move the carrier above the body of the vehicle by which it is to be moved, provides a mechanism for moving the carrier by the incline to dump the same, and provides a mechanism simple and operable by means of the power device convenient to farms and localities where an apparatus of this kind is employed most generally.

VARIABLE CHANGE GEAR FOR PLANTERS.—A. M. CRISMAN, Davenport, Iowa. The invention is an improvement in variable chain gear for planters use, and the object is to provide a device of the character specified whereby the movement of the seed dropping plates of a planter may be varied so that different amounts of seed may be planted in a hill without stopping the planter.

AUTOMATIC PLANTER AND CHECK-ROWER.—A. M. CRISMAN, Davenport, Iowa. The present invention is an improvement over a prior patent granted to Mr. Crisman, and its object is to provide an automatic dropping device for depositing a predetermined number of grains in hills at equal horizontal distances from one another, regardless of inequalities of the ground, and wherein a minimum of work is imposed on the measuring wheel, the actual operation of dropping being done by the carrying wheels.

Of General Interest.

LOADER FOR CONCRETE BATCH MIXERS.—W. H. TUTTLE, Moodville, Ind. This mixer is arranged to permit accurate measuring of the quantities of materials at the time they are filled into the loader, to allow convenient charging of the loader and delivering the materials to the drum of the mixer, at the same time supplying the water in a measured quantity, thus insuring the formation of batches of concrete of uniform consistency.

METHOD OF PREPARING SCREENS FOR COLOR PHOTOGRAPHY.—L. D. DU HAURON and R. DE BERZHOUL, Tonkin-le-Haut, Tonkin, France. It is sought in this invention to cover a transparent or translucent surface of glass, celluloid, paper and the like, with a very large number of exceedingly small rectangular figures, such as bands, rectangles, lozenge-shaped figures, etc., having three distinct colors placed closely together without leaving any interval, and each covering theoretically one-third of the surface. The process is rapid and economical.

DIE.—M. F. BUEMS, Leipsig, Germany. The invention relates to dies more particularly for use in stamping letters or other characters into printing metal. The aim is to provide a die so formed that the characters impressed into the metal thereby have no deleterious effect on the metal surrounding them, so that when impressing a character no lateral swelling or bulging of the metal takes place.

TOOTH FOR EXCAVATING BUCKETS.—E. L. PEMBERTON, New Haven, Conn. The object here is to provide a tooth having a detachable point, so secured to the body of the tooth that it may be reversed when desired. In practice the points usually become worn on the lower cutting surface, and it is the purpose to provide a tooth with a reversible point so that great additional wear may be obtained.

AUXILIARY DRAINING TUBE.—P. S. PLACE, Alfred, N. Y. The tube is for use in convenient insertion in a vein or artery of a human body to be embalmed, and it is arranged to permit its insertion to any depth to insure proper draining of the blood from the vein

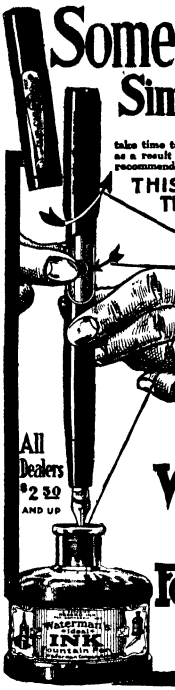
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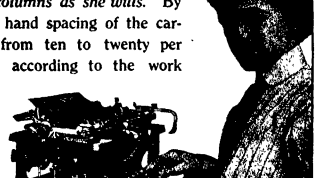
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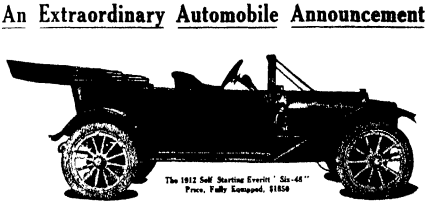
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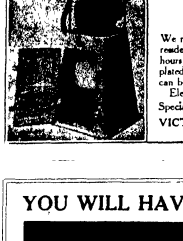
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or artery, and to allow convenient cleaning of the tube while the same is in use, with a view to keep the passage open for the blood to readily flow out.

GROUND ANCHOR.—J. SCHAUMBURG, Oschersleben, Germany. The purpose in this invention is to provide an anchor for removable connection with the ground and adapted to secure in place ropes, chains and the like, and the improvement is more particularly adapted to secure balloon or airship sheds, and devices pertaining thereto

Hardware and Tools.

OIL CAN RACK.—T. MILLER, Springboro, Ohio. In the present patent the invention consists in constructing a metal skeleton rack, shaped to secure an oil can of usual construction, and a spring pressure member to bear against the side of the can to hold the same firmly against holding members on the rack.

RAZOR.—H. J. MILLER, New Orleans, La. In this instance the invention has reference to razors, and has for an object the provision of a foldable razor having a blade removable from the shank of the razor, so that a new blade can be employed to replace the worn blade, and a guard to permit of cutting the beard or the like without marring the skin.

ATTACHMENT FOR LADDERS.—E. C. MEAD, Elkhart, Ind. In this invention use is made of notched retaining bars secured to the body of the ladder, railings mounted to swing on the bars, means on the bars and adapted to be disposed in the notches of the bars for adjustably supporting the railings and the last being provided with means for supporting packages or receptacles thereon

PIPE WRENCH.—L. P. FITZGERALD, Coalinga, Cal. This wrench is for use in handling pipes, oil well casings and the like, and more particularly to a device of this class comprising a handle, a head secured thereto and having a gripping jaw, a flexible member having one end movably secured to the handle, and means whereby the other end of the flexible member can be adjustably and removably secured to the handle

Heating and Lighting.

ATTACHMENT FOR GAS FIXTURES.—J. H. CATO, Kansas City, Mo. This attachment is adjustable to gas fixtures, and offers a suitable support for a number of brackets carrying smoke bells at their outer ends. An object of the invention is to provide an article which is capable of adjustment on the gas fixture, so that the smoke bells may be suspended in any desired position.

Household Utilities.

KNOCKDOWN COUCH.—I. E. EMERSON, Baltimore, Md. The invention provides portions of the adjacent chair structure which may be removed from normal position to be fitted between the adjacent chairs locking the same in fixed position and forming, in conjunction with the seats thereof, a bed mattress, and provides chairs with complementary auxiliary sections which may be removed from the normal position to form, in conjunction with other chairs and like complementary sections thereof, a reclining structure

Machines and Mechanical Devices.

SHEARING MACHINE.—J. F. LEAKS, Knoxville, Tenn. This invention is an improvement in shearing machines, and the object of the inventor is the provision of a simple and easily operated machine of the character specified, wherein the upper turret is moved angularly simultaneously with the lower turret, and is moved vertically with the ram toward and from the lower turret.

HORSE FEEDING MACHINE.—JOHN B. JONES, Fairmont, W. Va. The invention provides a machine wherein grain may be measured in bulk quantity to agree with weight, provides a machine wherefrom various quantities may be delivered, the regulator for said quantities being operated by means of selecting devices, and provides a simple and effective measuring device controlled by a simple construction to provide a variety of effects

FEEDING ATTACHMENT FOR TYPE WRITING MACHINES.—H. M. BUSCH, Atlanta, Ga. The invention relates to improvements in feeding attachments for machines for feeding envelopes, telegraph blanks, etc. An object is to provide a device by which an envelope or blank which is crimped, whose surface, therefore, is not in a single plane, may be fed through the device and with as much certainty as envelopes or blanks which are not crimped, and which, therefore, present a plane flat surface to the feeding member.

Designs.

DESIGN FOR A GLASS VESSEL.—C. F. FRANCH, Honesdale, Pa. The design in this case is representative of a wine glass or goblet, along very graceful and simple lines, the ornamentation comprising a band encircling the article near the rim, the band being decorated with a flower repeated and separated by interwining laces

NOTE.—Copies of any of these patents will be furnished by the SCIENTIFIC AMERICAN for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.



Kindly keep your queries on separate sheets of paper when corresponding about such matters as patents, subscriptions, books, etc. This will greatly facilitate answering your questions, as in many cases they have to be referred to experts. The full name and address should be given on every sheet. No attention will be paid to unsigned queries. Full links to correspondents are printed from time to time and will be mailed on request.

(12480) W. D. says: Astronomers state that the North Pole of the earth is inclined toward the sun 23½ degrees at the summer solstice, and the South Pole 23½ degrees at the winter solstice. They accompany this statement with a drawing purporting to show the inclination. The only proof given in support of this claim that the poles have such inclination in text-books on astronomy which I have seen is the change of the seasons. It seems clear that the change of the seasons could be accounted for on the theory that the earth's axis is parallel to the axis of the sun and that the plane of the earth's orbit intersects the plane of the sun's equator at an angle of 23½ degrees. If these conditions existed, the rays of the sun would reach 23½ degrees over the North Pole at the summer solstice and 23½ degrees over the South Pole at the winter solstice. Has it ever been mathematically demonstrated that the poles of the earth are inclined toward the sun as stated and illustrated in text-books on astronomy? Or is any proof given except the change of seasons? A. We are not able to agree with your statement that "the North Pole of the earth is inclined toward the sun 23 degrees 30 minutes," etc., since the pole is a point, and a point cannot be said to have an inclination to a line. We should say that the earth's axis is inclined to the plane of its orbit at an angle of 23 degrees 30 minutes, and this causes the north and south and southward apparent motion of the sun in summer and winter, thus causing the change of seasons. Nor as a matter of fact is it the case that the sun's axis is parallel to the earth's axis, nor does the plane of the earth's orbit intersect the plane of the sun's equator at an angle of 23 degrees 30 minutes. See Young's "General Astronomy," price $3, postpaid. Article 282. "The inclination of the sun's equator to the plane of the ecliptic is 7 degrees 10 minutes to the plane of the terrestrial equator it is 26 degrees 25 minutes. The axis of the sun is directed almost half way between Vega and the Pole Star." Two hundred years before Christ the Greeks had measured the inclination of the earth's equator to the plane of its orbit with a good degree of accuracy. It is half the difference of the altitude of the sun at noon on the day of the summer and of the winter solstice. It can be determined by the length of the shadow of a vertical pole at noon upon a level plane during a year. There is no reason for doubt that the position of the sun's equator in space is accurately known, and that of the earth's axis to the plane of its orbit. The seasons of the earth is a result of all this, but not a proof of this. Between these two there is a great difference.

(12481) W. P. says. Do you know of any material or composition of materials that the resistance will decrease or conductivity will increase, in proportion with the voltage or with the increasing of the voltage? I want to get some material that current will not pass through it at low voltage, but as the voltage increases, it will allow the current to pass through it. A. We do not know any material whose electrical resistance depends upon the voltage of the current to which it is opposed. Every conductor allows more current to pass as the voltage is increased, but this is not what you ask

(12482) W. G. T. says. A claims that thunder and lightning are caused simultaneously by the coming together of two oppositely charged clouds. B claims that thunder follows lightning, in that the thunder is caused by the air rushing together to fill a vacuum which has been made by the lightning's passage through the atmosphere. Who is right? A. B is correct in holding that thunder is caused by the air rushing back into the partial vacuum created by the passage of the electric discharge and the great heating of the air in the path of the discharge. The thunder is a result following the discharge of the electric strain in the air

(12483) W. C. H. asks: In your answers to questions will you kindly tell me the name of the brilliant star or planet high in southeastern sky which was passed by the moon on the evening of May 11th? Their distance apart was not over two to three degrees, I should judge. A. The planet whose name you request is Jupiter. You would be interested in following our monthly articles, "The Heavens for ————," published in the last issue each month for the following month. In these articles you will find the position of the visible planets given, so that you may always know where to look for them.

(12484) F. B. H. asks: Is there any method by which ordinary cats in periodicals can be transferred to lantern slides? A. A cut in a periodical may be transferred to a glass

plate to use for a lantern slide, by the deaf-nemesis process. Varnish the glass with a transparent varnish, and before the varnish is dry, rub the cut face downward upon the varnish. When all is dry, wet the paper and rub it off the glass carefully till all is removed and the cut is clear. If a second coat of varnish is put over the cut, probably the surface will be impaired. Any such transfer will of course ruin the cut. The best way is to make a negative from the cut, and then as many lantern slide positives may be made from the negative as you desire.

(12485) C. C. asks: Please explain whether a high-wheel wagon pulls easier than a low-wheel wagon, the wagon to be pulled by a team whose traces are horizontal and the wheels not to sink in dirt. A. On a perfectly hard surface and with frictionless bearings, the size of wheels would make no difference in the tractive force. But as such conditions never exist, the high-wheel wagon has the advantage of smaller leverage of friction and surface speed of journals, and of climbing over obstructions with a more gradual lift of the wheel and axle, and less abrupt angle of force, tending to stop the wheel in meeting the obstruction. The small-wheel system offers certain constructive advantages, lighter and stronger wheels, and no very great difference in tractive resistance on hard, smooth roads. The method of making a barometer is fully described and illustrated in SUPPLEMENT No. 909, price ten cents mailed.

(12486) R. H. S asks: I have always understood, and so taught, that the Moon revolved around the Earth once in a month, or twelve times, while we revolved around the Sun once. I saw an article that the Moon went only half way around and then returned to its starting point, and so continued. A. The Moon goes around the Earth each lunar month. It does not go half way around and then return. How could it? As well ask a base ball to stop in the air and return to the hand of the pitcher. The Moon is a heavy body in rapid motion, and cannot stop itself any more than a cannon ball can stop itself. There are, however, 12.4 lunar months and not 12 in a year, or the Moon goes 12.4 times around the Earth while the Earth goes once around the Sun. This causes the new Moon to fall in different parts of the month in the different months of the year.

(12487) W. C. F. writes: Construction No. 12456 by H. H. R. differs from that given in all textbooks for inscribing a regular pentagon in no essential feature. The line from C through the point of tangency passes through the center of the small circle, the radius of which is half the radius of the given circle. Therefore the distance from C to the point of tangency is equal to the greater segment of the radius of the given circle when divided into extreme and mean ratio, and hence equal to the side of the inscribed decagon. The rule might now be simply stated thus: Draw two perpendicular radii, and from the line joining the middle point of one to the extremity of the other, deduct half the radius of the given circle. The remaining segment will be the side of the decagon.

(12488) G. R. R. says: 1. How far will a 3-inch gun throw its projectile? A. 8,500 yards (this will vary somewhat with variations in the elevation). 2. How far will a 12-inch gun throw its projectile? A. 24,000 yards (this will vary somewhat with variations in the elevation). 3. How far will the new 14-inch guns (authorized for the two new battleships) throw their projectiles? A. 21,000 yards (this will vary somewhat with variations in the elevation). 4. How long is the U. S. magazine rifle bullet in the air during its maximum flight? A. The maximum range of the U. S. magazine rifle with an elevation of 45 degrees has been computed to be 5,460 yards with a corresponding time of flight of 31.36 seconds. 5. Give the penetration, in inches, through earth for the following projectiles: United States magazine rifle; field artillery; siege guns. The penetration of a magazine rifle in loam, practically free from sand, is 18.8 inches at a range of 500 yards. Simple penetrations, normal impact, for field and siege guns have not been determined. 6. Will these projectiles penetrate greater distances of earth at long distances than at short distances? A. No, because the projectiles will have a higher velocity at short distances than at greater ones. 7. What would be the probable number of transports, largest size, required to transport an army of 200,000 men from Japan to the western coast of the United States? A. Probably 100. 8. How long would it take such a fleet to make the voyage, considering that the fleet must keep together? A. The distance of the voyage would probably be about 4,800 miles, and as the fleet would be limited in its movement by its slowest vessel, probably ten knots per hour, the distance traveled per day would probably be about 240 knots. This would be on the assumption of no interference by the enemy and no accidents or other mishaps. 9. What opinion have you on the following hypothesis: Japan, without making any declaration of intention to attack any nation, commences to embark a large army of say 300,000 men on her transports at Yokohama and Nagasaki. What action would the United States take? A. As to question 9, there is no possibility of securing any serious opinion from any service man. They will not express any opinion either officially or otherwise, except in jest, such, for instance, as "issue a call for a peace conference," "call on Carnegie," and the like.

(12489) J. C. L. asks: 1. What makes this world turn on its axis? A. We are not able to say what force produced the rotation of the earth upon its axis. Its inertia in a space in which there is no appreciable resistance maintains its rotation. 2. Name two or three of the best diamagnetic substances. A. The more strongly diamagnetic substances are bismuth, antimony, tin, and copper, although no substance is as strongly diamagnetic as the magnetic substances are magnetic. 3. How far west of the true pole is the magnetic pole? Does the needle point there from any position on the globe? A. The north magnetic pole was located by the Norwegian explorer Amundsen in 1907 in latitude 75 deg. 5 min. north and longitude 96 deg. 47 min. west. The south magnetic pole was located by Lieut. Shackleton's party in 1908 in latitude 72 deg. 25 min. south and longitude 155 deg. 16 min. east. A magnetic needle at any place on the earth places itself tangent to the lines of magnetic force at that place. It points approximately in the direction of the magnetic pole, but only approximately, but it does not point constantly in the same direction. It changes from year to year. Going down into the earth to the slight distances to which we have penetrated does not affect the magnetic needle for the reason that it is below the surface of the earth. The cause of magnetism is not known. It seems to be a permanent condition of the molecule.

(12490) E. W. F. H. asks: Will you kindly inform me through Notes and Queries how many pounds (air pressure) a cylinder of steel 1/32 inch in thickness (such as seamless tubing with heads securely fastened at both ends) 2 inches inside diameter and 8 inches long, will hold with a reasonable margin of safety? If a tank is holding 50 cubic inches of air at 500 pounds pressure, how many cubic inches of air at 25 pounds pressure are contained in tank? I figure it to be 20 times 50 cubic inches, equaling 1,000 cubic inches at 25 pounds. A. Use the formula $p = 2 \times f \times s \div d$ in which

p = pressure in pounds per square inch.
d = diameter of tube in inches.
f = thickness of tube in inches.
s = tensile strength.

Thus $p = 2 \times 1 \div 32 \times 60{,}000$ and $p = 1875$ pounds per square inch. This is the bursting pressure for the cylinder if made of steel of 60,000 pounds tensile strength. You must introduce a factor of safety, which for compressed air may be 5, which gives as the safe pressure as 375 pounds. Your solution of the tank problem is correct if the pressures are absolute, or pressures above vacuum. If they are gage pressures, add 15 pounds to each to convert them to absolute pressures, and solve by proportion as before.

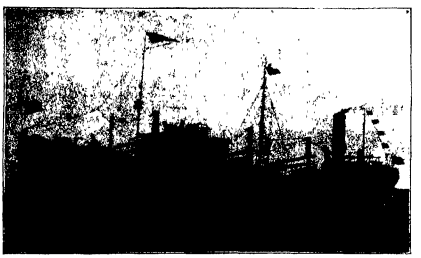
(12491) J. P. F. asks: I have built a store room 22 foot front and 75 feet deep, ceiling 14 feet high. Front of building is all glass with two windows in back, which gave fair light. Building is facing south, with an awning stretched over it. In the day time one can hardly see the goods in the show room from the outside, owing to the glare of light, cloudy days it is some better, there is no background to show window. Lit up at night by electric light shows off well through window. If there is any way of remedying the trouble you will confer a favor by helping me out. As we are not quite clear as to the arrangement of the show window and store, but it is apparent that you need a background in the window to throw back the light on the goods behind the glass. The background need be only 4 to 6 feet high, so that light will pass over it into the store behind. If the store lighting is bad with the background in place, prism glass in the upper part of the window will project the light back sufficiently.

(12492) F. E. L. asks: Can any two or more chemicals, either liquid or dry, be brought into contact (not forcibly) and cause a quick combustion? A. There are a good many substances which take fire upon coming into contact. The end of a match and sandpaper, the safety match and the side of its box are examples. Phosphorus and iodine will ignite by mere contact without friction or pressure. 2. Are there any chemical substances which upon being exposed to the air will burn almost instantly? A. Hydrogen and chlorine gas mixed in equal parts will explode by letting the sunlight fall upon them. Impure hydrogen phosphide gives a very interesting case of spontaneous combustion when it escapes into the air. 3. Are there any chemicals which upon being exposed to certain gases burn almost instantly? A. Finely divided phosphorus will take fire almost instantly when it comes into contact with the air. These and many other chemical experiments of equal interest are described in Bendier's "Chemical Lecture Experiments," which we will send for $2 by mail. No such experiments should be attempted without special precautions against flying glass or fire, except by a person already experienced in chemical manipulations. They are not adapted to a careless amateur.

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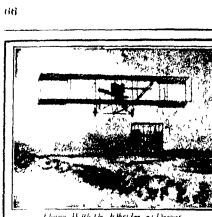
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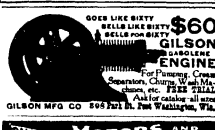
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NEW BOOKS, ETC.

ENGLISH FURNITURE. By Frederick S Robinson London: Methuen & Co. Large 8vo, 365 pp 160 plates.

This sumptuous volume belongs to the connoisseur's library. The book itself is beautifully gotten up and is elaborately illustrated, although we must admit we do not like massing all of the plates at the back of the book, which would be much more usable if they were interspersed among the text; still it is almost a pity to criticise such an illuminating and informing book. English furniture at the present date supplies one of the most interesting links for the collector, and the aim of this book is to assist those who collect or who purpose collecting. The subjects of the plates show a tendency to avoid the more common styles, but give a few of the general types with which a collector may meet. A false idea of English furniture would be formed if a majority of the plates reproduced were only such as are seldom or never found for sale but at the same time serve as examples of the skill of the old cabinet maker. Reproductions from the pattern books of Chippendale and his successors have been avoided. The book will be of great use to those who are not versed in the study of English furniture. Chippendale, Manwaring, Ince, Mayhew, Adams, Sheaver, Heppelwhite, and Sheraton are almost household names in this country as in England. Typographically the book is one of the best that we have seen for a long time.

THE FURNITURE OF OUR FOREFATHERS By Esther Singleton With critical descriptions of plates by Russell Sturgis New York, Doubleday, Page & Co., 1908. 8vo, 664 pp $6 net.

There are happy hours before the old furniture enthusiast who picks up this fine collection of plates with the accompanying text giving wonderful inventories of household goods, stories of the belongings of notable personages, and descriptions of the crowding with the useful and often highly ornamental chattels of vanished days. Part I dealing with early Southern furniture, presses upon our notice a wealth of industrial pieces taken rabbits showing Flemish influence, walnut chairs with baluster-shaped legs and arcade-pattern backs, tables and cupboards of oak with the carvings fluttings and linked designs common to the period. Next we see a cradle, too, from an old Worcestershire manor house, with punched hood and cushions of figured velvet. In later Southern furniture we are presented with examples such as William Penn's desk, a quaint chair used by Thomas Jefferson when writing the Declaration of Independence the reading desk of John Dickinson, and a library chair belonging to Benjamin Franklin the seat of which is oblong; tips to form a step under. Part III continues the list with early New England and the imported and home-made pieces of the seventeenth century. Part IV gives us the Dutch and English periods, with church stools warming pans, kas, or mammoth chests and cupboards, fine examples in marquetry chairs from the Gansevoort and Schuyler families, and hall clocks of quaint design. Part V summarizes the work of the eighteenth century, with its beautiful sofas, tables, and chests of drawers. Part VI is devoted to Chippendale, and the plates show most beautiful examples in cabinets, chairs, lounger in bloc, settees and mirrors. Parts VII and VIII continue the history of furniture through the early part of the nineteenth century and quite fulfill the expectations aroused by the foregoing sections of the work. A mere enumeration of the most striking features can not do justice to the work as a whole. It is one to be fingered over, and returned to time and again.

PEUT-ON VOLER SANS AILES? By Paul Collard Paris: Librairie Aéronautique, 1911 8vo, 109 pp., illustrated

Here we have exploited a new type of heavier than air flying machine, designed to shift the burden of support from wings to propeller. This result is brought about by an upward inclination of the propeller shaft. The inventor names his conception the "Aerobil," and claims for it many advantages over the spread-angle aeroplane at present in vogue. The theories and results are impressed upon us by reiteration and are even reduced to formulæ. Among other virtues the security is that of a level landing instead of the head on approach to earth now made necessary in bringing an aeroplane to the ground. Provision is made for safe alighting in case of engine failure, and the transverse stability of the Aerobil is supposed to be to a great extent automatic. The inventor is very much in earnest and writes with the sincerity of conviction.

THE WORLD WIDE ATLAS OF MODERN GEOGRAPHY, POLITICAL AND PHYSICAL Introduction by J Scott Keltie, L.L.D., Edinburgh and London W. & A K Johnston, Ltd., 1911 Small 4to; 128 plates and 98 page Index Price, $3

It is astonishing to see what a very usable atlas can be obtained for such a moderate sum. The publishers are known for the quality and accuracy of their work. The maps are clear, not overburdened with too much detail and show every indication of being thoroughly up to date. The production of an atlas is a serious and expensive undertaking, and atlas makers of this country have much to learn from British and German map makers, particularly as regards size. This atlas is small and light in weight, but is fully as informing as many American atlases of three times the superficial area. The United States is very apt to be neglected in such foreign works of reference, but it is not in the present instance. The South American maps are especially good. British possessions all over the world are admirably treated.

LE CONSTRUCTEUR DE CERFS-VOLANTS 1 re Serie Cerfs-Volants simples. G. Dubouchet et J. Frotche. Paris: Librairie Aéronautique 8vo.; 24 pp.

Kite flying is one of the most ancient and honorable divisions of mankind, and the fact that the modern aeroplane partakes very much of the nature of a motor-driven kite lends new interest to an old pastime. This pamphlet is the first of a series on kite construction, and contains folders which show plans for four of the simplest kites known—the tear-shaped, the hargrave, the hexagonal, and the oblong. Very plain instructions accompany the drawings.

ANCIENT MYTHS IN MODERN POETS. By Helen A. Clarke. New York Baker & Taylor Company, 1910. 12mo.; 360 pp Price, $2 net.

A beautifully printed and most beautifully bound book, well illustrated "The Prometheus Myth from Hesiod to Shelley" and "The Moon and the Sun from the Homeric Hymns to Keats" is the full contents. The author has written "Hawthorne's Country", "Browning's Italy", "Browning's England", "A Child's Guide to Mythology," and "Longfellow's Country," which show an appreciation for some of the fascinating phases of literary environment. Several of the illustrations are taken from the paintings of Max Klinger and one from Watts, both strong portrayers of the poetic side of myths. The binding is particularly handsome, showing a judicious combination of colored leaf and gold.

ENGINEERING LAW VOL. I THE LAW OF CONTRACT By Alexander Harding, C.E., LL.B., LL.M. Chicago 1911, The Myron C. Clark Publishing Company, 1910. 8vo, 518 pp Price, $4 net.

As is indicated by the title of this volume, the book is intended particularly for the use of engineers and engineering students. It presents a condensed text of the law of contract as applied to engineering, or rather as the law of contract has been developed in connection with cases and adjudications in solving engineering subjects. The underlying principles of the law of contract are of course the same as those which applied by or to the engineer, or otherwise. Consequently, the author has properly sub-divided the subject, and in each sub-division sets forth concisely and logically the principles then under. At the end of each sub-division were given numbers of cases exemplifying the principles and showing their application to engineering. The authors purpose in writing this volume of his work is to give the student as well as the practicing engineer, an understanding of the subject sufficient to guide him in meeting the legal phases of whatever branch of engineering may be the field of his activities. As stated in the preface, the author does not believe that the case system of teaching law is the best one for engineering, and that on the other hand the text-book method alone, does not enable the student to understand fully, how the courts work out the rules of law in connection with concrete facts. As a result, he has combined, and most judiciously, the two methods as stated above. This volume of engineering law will prove useful not only as a text book, or for use in connection with lectures in technical schools, but also as a work of reference for the practising engineer.

THE DAWN OF MEDITERRANEAN CIVILIZATION By Angelo Mosso Translated by Marian C Harrison New York. The Baker & Taylor Company, 8vo; 424 pp, 203 illustrations. Price, $4 net.

The fascination of prehistory, as Prof Mosso calls it, clings to these pages in no small degree. Things which most men would pass by as broken pottery and decaying bone are made to yield up to us a story of life in prehistoric times telling us of the beliefs observations, customs, and passions of bygone races, and leaving us with that feeling of renewal and regeneration which comes of contact with childhood in any form, racial or individual. In other words, far from feeling that we have made a journey into the grave, we are given a new strength and clearness of vision which enables us to see more vital things. The reader accompanies the author upon his expeditions, participates in the joy of his discoveries, and follows him as he reasons back from the physical features of his find to the mental characteristics which determined them. Who can hear mention of such topics as the origin of writing, the origin of art in religion, the coloration of the body, or pre-Homeric navigation, without being at once eager to know what research teaches us of them? And when, as in the present instance, inscriptions and weapons and carvings are put before us in such profusion, and the argument from them back to their makers is so simply stated, we can not but feel something of the thrill of discovery which energizes the writer and en-



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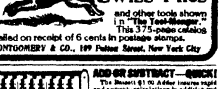
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THE GARDEN MONTH. Describing the appearance, color, dates of bloom, height, and cultivation of all desirable hardy herbaceous perennials for the formal or wild garden, etc. By Mabel Gabot Sedgwick, assisted by Robert Cameron New York: Frederick A Stokes Company. 8vo.; 516 pp.; Illustrated Price, $4.50 net

All the scattered lore of floral catalogues, magazines, and handbooks seems to have been brought together here in most attractive and helpful form, with the addition of much that it would be hard to find elsewhere. To begin with, there is a large color-chart showing the tints of flowers and naming and numbering them, so that in the descriptive lists following the exact color of any flower may be determined by a reference from the tint number there given to the same number on the chart Sharp line drawings are interspersed showing the more noteworthy plants and blossoms. There are also descriptive lists of water plants, of foliage plants of vines and climbers, and of ferns An index of both botanical and English names furnishes ready access to any required information In the main body of the work each page is headed with the name of a month and is divided into six columns In the first column is the color-number of the flower in the second its English name, in the third its botanical name The fourth column contains a brief description of its appearance, often with a reference to an excellent illustration, the plant with which it is best suited—the rock garden, the border, the ornamental bed; its mode of propagation, the soil which it requires, and other notes of interest The fifth column states the height to which it grows, and whether in sun or shade The last column states the time of bloom Many disappointments and mistakes may be avoided by a reference to this compendium By its use in conjunction with the color-chart, the gardener *may* visualize his proposed color scheme and make sure that his floral picture, when finished will be artistic and satisfying

THE AUTOMOBILE. Its Selection, Care and Use. By Robert Sloss. New York Outing Publishing Company, 1910 12mo , 194 pp Price, $1.25.

Like Tennyson's brook, the stream of books designed to aid a man in choosing and running an automobile bids fair to go on forever What do I want to use my car for? is the question the would-be purchaser is urged to ask himself. And upon the answer to that question and the nature of the roads over which the car must be driven, depends the future satisfaction and comfort of the hero in his new acquisition The chapter on 'mechanical tips' puts the reader in possession of much information that may save him from the misleading statements of agents and qualify him to judge intelligently of the attributes and possibilities of the car he is trying out. The sections on "the care of your own auto" and "driving with brains" continue to furnish knowledge that the tyro must sooner or later acquire, if not by previous study, then by hard experience Trouble-finding and the care of tires, with the use and equipment of the car on tour and in camp, bring to a conclusion the brightly written little treatise

THE ELEMENTS OF GRAPHIC STATISTICS By William Ledyard Cathcart and J Irvin Chaffee, A M. New York. D Van Nostrand Company, 1910 8vo , 312 pp , 159 illustrations Price, $3 net

"Graphic Statics" is a survey of the field of balanced forces, in which geometrical constructions are used instead of algebraic analyses. By this method it is possible to represent the magnitude, direction and point of application of a force by the length, inclination and position of a simple straight line. The gain in conciseness and ease of demonstration is apparent After expressing the principles of graphic arithmetic, the authors turn to studies of forces and moments, the fundamental laws of tension, compression and reaction as applied to beams; roof trusses; bridge trusses; and the graphics of friction The work is particularly addressed to students of marine engineering and naval architecture, and the principles of graphics are shown in their application to mechanisms as well as to framed structures. The final section of the volume presents a series of moment diagrams for shafting, with test problems appended.

APPLIED THERMODYNAMICS FOR ENGINEERS. By William D. Ennis, M.E. New York: D. Van Nostrand Company, 1910. 8vo.; 438 pp.; 216 illustrations. Price, $4.50 net.

The shortest for supremacy between the steam engine, the gas engine, and the turbine furnishes one of the most stimulating spectacles of modern progress. The advantages and drawbacks of each, with the determined efforts of engineers and inventors to increase the one and reduce the other, leads us into a competition that at least results in pushing forward the efficiency of the prime mover in a field of its own work and recreation of the world. The text-book in hand maintains that thermodynamics is neither mathematics nor logic, but physics, and hence should be presented in a middle course that proceeds from ideal operations to their modification in practice, with the development of underlying principles—stopping before these principles harden into machine design Sound theory is given precedence over rules of practice so that the student may first acquire a confident grasp of underlying laws which will enable him to attack new problems successfully, varying his rules to meet the exigencies of the particular problem in hand The cuts and diagrams are plentiful and clear Problems are appended to each division of study so that their working out may lead to a perfect understanding of the preceding lesson Chapters on compressed air and mechanical refrigeration are incorporated, and the gas producer receives its share of attention

THE ELECTRICAL NATURE OF MATTER AND RADIOACTIVITY By Harry C Jones New York: D Van Nostrand Company, 1910. 8vo ; 210 pp Price, $2 net

Some years ago a series of articles appeared in the *Electrical Review*, dealing with these two correlated subjects It is this series, revised, and with the more important of the recent discoveries added, which forms the volume in hand The leading facts and deductions are presented in language as free as possible from mathematical terms A popular elementary dissertation and treatment has been the aim, without any sacrifice of accuracy There are chapters on the nature of the ion *inside* and of the atom, on the radioactive substances in pitchblende and the properties of radiations, on the production of radioactive matter, and on theories and generalizations

THE FINE ART OF FISHING By Samuel G Camp New York Outing Publishing Company, 1911 12mo., 177 pp Price, $1 net

This attractive little brochure is in essence and in name a reminder of H P Wells's declaration that the angler considers his sport as a fine art, of which merely to obtain fish is a small part It is the way the thing is done" In Fishing Kits and Equipment the writer described the mechanical means of casting for fish In the present papers he concerns himself rather with the approved methods of using these mechanical means Since the methods must vary with the kind of waters fished and the kind of fish sought, the papers resolve themselves into discussions of our common game fish and their haunts, with the most approved usage in fly and bait casting The numerous plates are for the most part inspirational rather than daily instructive, and a vein of catching enthusiasm runs through every chapter

SOCIALISM A Critical Analysis By O D Skelton, Ph.D New York Houghton Mifflin Company, 1911 8vo , 329 pp Price, $1.50 net

In a contest inaugurated by a Chicago firm, this analysis of socialism was awarded first prize The introductory chapter wisely refrains from any attempt at a final definition offering instead a brief historical survey of socialistic systems past and present The indictment against capitalism is then set forth its exaggerations and lack of perspective pointed out, and the impossibility of a lawless order is urged Socialistic views are given over to the Marxian system—the materialistic conception of history, value and surplus value, and the law of capitalist development The modern socialistic ideal is summarized in so far as the writer can give it form, and the socialist's attitude toward industrial and other problems is analyzed as fluid, if not vaporous That is the socialist refuses to submit published plans for his ideal order and revolts against the tyranny of detail The writer has at least succeeded in placing in a high light the complexity of the factors entering into the question, and his canvass is not lacking in interest, although he seems to be almost personal conviction and his tentative setting forth of possibilities can hardly be dignified by the name of conclusions As an analysis, the essay is comprehensive, as a critical estimate it is barren of results

THE BOY SCOUTS OF THE EAGLE PATROL By Lieut Howard Payson New York Hurst & Co 1911. 8vo , 302 pp. Price 60 cents

The essential elements of the plot are provided by a trio of youthful criminals who seem to regard burglary and kidnapping as huge jokes Their schemes are directed against the boy scouts in revenge for imaginary slights, and they are assisted by a disreputable old reprobate who has served time in jail for smuggling The chapters in which three of the scouts are towed out to sea by a shark lost in a thunder squall, and almost run down by a liner, have enough incident in them to satisfy the strongest craving. Aside from the quarrelsome blackness of two of the young villains, which has been put on with rather too thick a brush, the story is well-calculated to make a host of boy friends and to inspire them with courage and a desire to learn something of woodcraft, telegraphy, and aeronautics

VOZDEI FREMDER LANDER. Von Dr K. Floericke. Kosmos Gesellschaft der Naturfreunde. Stuttgart: Franckh'sche Verlagshandlung.

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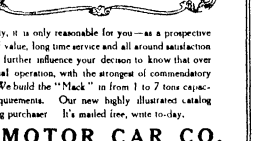
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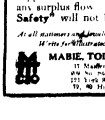
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(Continued from page 67)

Merchant Marine as an Auxiliary to the Navy

(Continued from page 50.)

that an adequate merchant marine can be built up by subsidies and discriminating duties jointly. With two means available of accomplishing a desired result, it is a sad commentary upon our practical statesmanship if our people cannot get together upon some measure of relief. In default of this we are guilty of deliberately perpetuating an endless procrastination, for which the foreign shipping interests are the most greatly obliged, to say the least. In the meantime, let us be prepared for the usual tirade against subsidies, accompanied by descriptions of the splendid imaginary shipping of the free-ship fallacy from anonymous newspaper articles and stuffed editorials, interposing all possible obstacles in the way of any legislation which shall wrest from the foreign shipping companies that portion of our own commerce which we must necessarily possess in order to control our own ultimate destinies.

Present Status of Cancer Research

(Continued from page 49.)

cancers and by special methods of examination peculiar bodies have been shown to exist in cancer cells, and these various parasites have been considered to be the cause of cancer. These parasites have been injected into animals in order to produce cancers, but as yet apparently no true cancers have been noted as a result of these injections. In many cases collections of new formed cells have developed, but as a rule these have not shown the distinct characteristics of a cancer, and the possibility exists that the development of a cancer in an isolated case when an animal has been injected with various micro organisms may possibly be due to the spontaneous development of cancer independent of the injection of the micro-organisms.

As to the possible influence of pure chemical or physical factors upon the development of cancer or the growth of cancer cells, we possess certain observations. Thus it has been shown that the activity of inoculated cancers may be experimentally increased or decreased by the action of these agencies. When tumors are heated for various lengths of time their power of growth is diminished. When they are subjected to a constant irritant, the power of growth is increased. In a similar manner the action of certain chemicals may decrease the activity of proliferation of cancer cells, on the other hand in animals fed with certain substances the rapidity of growth of inoculated cancers is increased. In this respect the conditions influencing the growth of cancers are similar to those which act in the case of normal tissue, and it is being recognized more and more that the study of normal tissue growth will throw light on the questions of cancer growth, and that a study of cancer growth may clear some of the questions of tissue growth.

That chemical stimuli may influence the proliferation of normal cells has been shown in certain cases. Thus when certain chemicals were injected under the skin of rabbits it was noted that the cells of the skin took on an increased power of growth, thus were stimulated by these chemicals. However, it has not been possible to produce a cancer by this means.

Distinctly suggestive are the results of experiments which have shown that under certain conditions, namely, when certain tissues had been sensitized or prepared by being acted upon by specific substances found within the body, the action of a mechanical stimulus was sufficient to cause those sensitized cells to proliferate rapidly. While in these cases a true cancer was not formed, since all growth ceased after a certain period of time, we have at least the experimental evidence that under certain conditions sensitization may so influence cells as to cause after the action of a mechanical stimulus a marked increase in their proliferative power.

The study of cancer in lower animals has given great opportunity to test various methods for either curing or preventing cancer. As yet no method to cure cancer has been found. Neither treatment with drugs nor serum (especially prepared in order to destroy cancer cells) nor with so-called vaccines[1] has been able to check the growth of a cancer when once it has started to grow.

On the other hand definite results have been obtained as regards rendering animals resistant to cancer. In animals in which a cancer has been inoculated, it is occasionally noted that the implanted cancer grows for a short period of time, but later becomes smaller and disappears. When such animals are inoculated with cancer a second time, in the majority of cases the cancer cells do not grow, such animals are said to be immune or resistant to cancer. It may, however, be noted that occasionally when these animals are inoculated a third or a fourth time, the cancer may grow so that apparently this resistance to cancer is not absolute in every case.

Furthermore in certain cases when relatively large quantities of cancer material were injected, and did not grow, many of the animals so injected were resistant to a second inoculation of cancer material. It has likewise been noted that where normal tissues of mice, such as liver, spleen and blood cells were injected into other mice, the subsequent inoculation of cancer cells does not lead to the formation of a cancer.

It has also been shown that when animals are treated with cancer cells whose activity has been lessened by experimental means, that these animals became under certain conditions resistant to a second inoculation of cancer, so that no growth results.

It may be noted that in every one of the instances cited above, living cells have been used in order to render the animals immune to cancer. The inoculation of dead cells apparently cannot lead to the immunization against cancer.

The knowledge that a previous inoculation of animals with either cancer material or normal cells caused such animals to become resistant to cancer led to attempts to cure cancer in human beings by similar methods. Cancer cells which had been ground to a very fine pulp were injected into persons suffering with cancer; in a few cases the results of such injections appear to have been beneficial, but from the data on hand at present it seems doubtful that this treatment is curative.

Various investigators who adhere to the belief that cancer is caused by micro-organisms have advanced other methods for treating cancer. Thus sera have been prepared which were intended to destroy the parasites or neutralize their poisons. These sera have been used in treating animals suffering with cancer. Other investigators have attempted to cure cancer by injecting the dead organisms which they have considered to be the cause of cancer. The consensus of opinion as regards these methods of treatment is that they are scarcely likely to prove successful, for, if cancer be due to a parasite, we have still to discover what that parasite may be.

It may be stated that in various animals which have been inoculated with cancer and in which the cancer grows for a short time but later disappears[2], it has not been possible to demonstrate any substance in the blood which would delay or prevent the growth of cancer in another animal. This absence of an anti-cancerous substance in the blood of animals which have recovered from cancer would appear to differentiate cancer from the most of the diseases caused by micro-organisms; for in most infectious diseases one finds in the blood of individuals who have recovered from an attack, substances which either prevent or minimize the severity of a second attack or which destroy the organism causing the disease. Therefore it would appear that the cure of cancer will not be found by pursuing the same lines of research as were and are being followed in seeking cures for the diseases caused by micro organisms.

In considering the various treatments of cancer which have been tried within the last few years, at least a passing word must be said anent the use of the X-ray.

[1] The vaccines used in treating cancer are analogous to small-pox vaccine, and are composed of substances extracted from cancer cells, or of cancer cells whose power of growth has been experimentally weakened.

[2] There is a distinct difference between inoculated cancer and spontaneous cancer; a certain percentage of cases of inoculated cancers show this retrogression; spontaneous cancers, however, very rarely retrogress.



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and radium. Both of these have been tested upon human beings, and upon animals, and although in a few cases they appear to have cured cancers, it is evident that in the majority of cases they are not effective. Their action depends upon certain rays of light which kill the cancer cells, and while they frequently are effective in destroying such cancers as originate from cells of the skin, which are superficial and accessible to these rays, naturally these rays cannot penetrate and destroy cells of cancers which are within the body.

In a certain small number of cases of cancer in human beings it has been noted that the tumor ceases to increase in size, then grows smaller and finally disappears In one such case, following the spontaneous cure of a cancer in the abdomen, there developed in the peritoneal cavity a collection of fluid similar in character to the collection of fluid noted in kidney or heart disease. This fluid was withdrawn from the abdomen of the cured individual and was injected into persons suffering with cancer (it was hoped that this fluid might contain anti-cancerous substances). While in some cases the injection of this fluid seems to have benefited the patients, it does not seem probable that this method of treatment will prove to be of curative value.

Modern experimental investigation has therefore not as yet shown the cause of cancer. It has, however, definitely shown that the problem of cancer is intimately related to the problem of cell growth, and it is along this line that future work must be directed. As to whether the primary cause of cancer be a micro-organism or whether we must look to some change in the nature and function of the cell itself for the explanation of the origin of cancer, we are not in a position to state.

Nor has any successful treatment for cancer as yet been found The use of specially prepared sera containing anti-substances which either destroy the cancer cells or the parasites which are supposed to be the primary cause of cancer has not been successful Nor has the use of various chemical substances or various kinds of light rays

However, within the next decade our knowledge of cancer should be largely increased. At present there are in the United States five laboratories or funds which are working especially in the search for knowledge regarding cancer; thus at Harvard University there is a department for cancer research, at Buffalo there is the State Cancer Laboratory, at Columbia University special work is being pursued under the auspices of the Crocker Cancer Fund. At Cornell University Medical School also a special fund exists. In St. Louis the Department of Pathology of the Barnard Free Skin and Cancer Hospital is concerned almost entirely with investigative work along the lines of cancer research At the Rockefeller Institute also cancer research is done

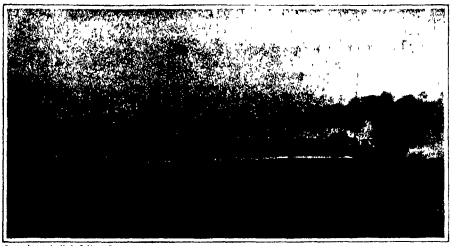
In England under the Imperial Cancer Research Fund, which has large means at its disposal, experimental and statistical work is conducted. In Berlin there are two special institutions for cancer research In Heidelberg, in Moscow, and at the Pasteur Institute in Paris, work is being conducted. Besides the investigators working in these special laboratories, there are many individual investigators both in this country and abroad who devote much or all of their time to this subject. In addition to these laboratories there are several hospitals, in some cases connected with the laboratories, which treat only cancerous cases.

Now that the fight against tuberculosis is well established both in lines of scientific research and in efforts toward public education and that it is generally recognized that scientific research will gradually add to our already acquired knowledge of how to control and cure the various infectious diseases, there still remains the crying need for support for investigative work in the lines of cancer research. For cancer is certainly one of the diseases which human beings have most to fear both on account of the inability to cure (except by early excisions) and the frequent occurrence of this disease. The endowments and financial means at the disposal of these laboratories mentioned above during considerably less than the largest of them have really ample means to carry on the work on such a scale as it should be carried. It will only be by placing sufficient means at the disposal of the various investigators that we may hasten the eventual success of the research as regards the cause and cure of cancer.

Weather Insurance

INSURANCE against bad weather is just now the subject of much discussion, *pro* and *con*, in the English newspapers and scientific journals. Two articles on this question appear in the April number of *Symon's Meteorological Magazine*. Dr. Mill, the editor, quotes from *The Times* the prospectus of the Excess Insurance Company, Limited, which offers four forms of rain insurance policy, known as Pluvius "A," "B," "C," and "D." The first provides for compensation in case within a specified week there are more than two days on which rain falls to the amount of over 0.20 inch. The premium is one-eight of the weekly compensation, thus, £1 per week premium would bring £8, in case the limit of rainfall was exceeded within the week Pluvius B provides for payment for every day on which the rainfall exceeds 0.20 inch, and the premium per week is one and one-half times the compensation payable per day Pluvius C takes account of smaller falls of rain, and offers compensation for the second and each additional "rain day" (a day with 0.01 or more of rain) in every separate week having a total rainfall exceeding 0.15 inch. The premium per week is equal to the amount payable per day Pluvius D provides for four consecutive days, and under it payment will be made for every day on which the rainfall exceeds 0.20 inch The premium for four days is equal to the compensation to be paid per day. Proposals for policies A, B and C must be made at least seven days, and for policy D at least two days before the period begins.

It is pointed out in one of the articles referred to that the term "compensation" is inappropriately applied to the money that the company will be required to pay in the event of a certain contingency that may not involve a loss, pecuniary or otherwise, to the insured A man residing in London, for instance, may take out insurance against the occurrence of rain at Liverpool during a certain week, though he may have no intention of visiting the latter place and the rain that may fall there may in no way affect him In this case the transaction becomes a pure gamble Supposing, however, that the policyholder is really seeking to indemnify himself for a spoiled holiday—or for the loss of gate-receipts at some out-of-door entertainment of which he is the promoter—the vagaries of a rain storm may defeat the best intentions of both insurer and insured. The policy provides that, within a certain district, the readings of a specified raingage shall determine whether the company is liable for the amount of the policy However, rain is often so local a phenomenon that the gage may record a heavy shower when the policyholder, a few miles or even a few rods away, may not experience a sprinkle In this case he collects his insurance though he has suffered no damage On the other hand, he may get a drenching from a local storm that does not contribute a drop of water to the gage, thus suffering damage for which he is entitled to no compensation This is but one of the elements of uncertainty that enter into the question the plan assumes, for example, a much higher degree of accuracy in rainfall measurement than should be expected of the average observer If the total rainfall up to the moment of observation is near to the critical amount, the observer's personal equation may easily vitiate the result. A rain gage is rarely read exactly at the nominal time of observation; and a deviation therefrom of a minute or two, if heavy rain is in progress at the time, might threw the measurement one side or other of the critical value. Even the question of disposing of the third decimal, where the gage is read to the thousandth of an inch—a matter of no importance from a scientific point of view—might involve the loss of



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ISSUE OF AUGUST 12th, 1911

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The next magazine number of the Scientific American, August 12th, 1911, will contain a series of articles by leading authorities, which will deal with this vital subject of the conservation of our natural resources.

Ex-Chief Forester the Hon. Gifford Pinchot, whose earnest fight for the preservation of the coal lands of Alaska has led to a favorable decision of the Land Office, which greatly strengthened the cause of conservation, will open the number with an article on the Conservation of our Forests.

The Director and Chief Engineer of the Reclamation Service, F. H Newell, will write a general article on the past work and future plans of the Reclamation Service. In its freedom from political interference and the high professional character of its personnel, and in the permanent nature of its engineenng work, this branch of our national conservation is deserving of the highest praise. Mr. Newell's article will be supplemented by several others written by the Resident Engineers in charge of the principal projects.

The Director of the Bureau of Mines, Dr. Joseph A. Holmes, will show that the waste of our supplies of coal is due not merely to careless and extravagant management in the mining of the coal, but also and very largely to methods in burning the fuel. Poorly designed furnaces and badly constructed smoke-stacks, which inevitably result in excessive smoke production, are answerable for much needless waste of coal.

Dr. David T. Day, of the United States Geological Survey, will prove, in an article on the conservation of oil and gas, that, as with coal, so with oil and gas, it is possible to effect large economies by judicious management in the oil and natural gas fields and by the use of improved appliances in burning these fuels either for light or power purposes.

Dr. Hugh M. Smith, Deputy Commissioner of Fisheries, will contribute an article on the Conservation of Fish, Oysters, etc., and Seals. Conservation is a word to which we are liable to give too restricted an application. We are apt to think in terms of forests, mines and other resources strictly related to the land, forgetting that the food supplies in the seas and rivers are subject to as ruthless a waste and call for as careful a conservation as any of the resources of *terra firma*

In addition to the above articles, the August 12th number will contain the usual Editorial, Aviation, and other Departments.

thousands of dollars to the insurer or the insured

To the meteorologist the whole scheme appears to border on pure speculation, and not to be reducible to the scientific character of ordinary forms of insurance There does not appear to be any attempt, even, to take into account the geographical and seasonal distribution of rainfall The projects of this character thus far put forth apparently assume that the risk is the same whether the place covered by the insurance has a mean annual rainfall of 25 inches or 50 inches, and whether the period in question falls at a time of year that is usually dry or the reverse

The complications involved in formulating a really equitable scheme of insurance against rain are so numerous that no actuary having a moderate knowledge of meteorology would think of trying to solve the problem.

Dreams That Came True

A PROVERB, which by constant reiteration has become somewhat musty, tells us that "Truth is stranger than fiction," and we have constant evidence of this outstripping of romance by reality It is not so generally known that romance has often anticipated sober fact; but such is the case In the present article it is proposed to enumerate a few instances which appear o be of unusual interest

In the year 1869 the Suez Canal, one of the most important engineering enterprises ever undertaken, was opened to the world's traffic. It was foreshadowed as long ago as the sixteenth century by Christopher Marlowe, one of the early English poets, in the following lines:

> Thence marched I into Egypt and Arabia,
> And here, not far from Alexandria
> Whereat the Terrene and the Red Sea meet,
> Being distant less than full a hundred leagues,
> I meant to cut a channel to them both
> That men might quickly sail to India."

It may be urged with reference to this quotation that so soon as it became possible to make an approximate y correct chart of the world the advantage of cutting through the Isthmus must have been apparent to many, and that Marlowe merely reflected the thought of others This, of course, is likely to be the case; but no such plea can be urged against the very curious anticipation of wireless telegraphy by Strada, the Italian historian, who was born at Rome in the year 1572 Addison quotes Strada in one of his noted essays, but we need hardly say that in doing so he had no notion of any anticipation of the electric telegraph, for Addison died just a century before communication by that means became possible Addison writes thus:

"Strada, in one of his prolusions, gives an account of a correspondence between two friends by the help of a certain lodestone which had such virtue in it that if it touched two several needles when one of the needles so touched began to move, the other, though at never so great a distance, moved at the same time and in the same manner He tells us that two friends, being each of them possessed of one of these needles, made a kind of dial-plate, inscribing it with the four-and-twenty letters, and in the same manner as the hours of the day are marked on the ordinary dial-plate. They then fixed one of the needles on each of these plates in such a manner that it could move round without impediment so as to touch any of the four-and twenty letters Upon their separating from one another into distant countries, they agreed to withdraw themselves punctually into their closets at a certain hour of the day, and to converse with one another by means of this, their invention . . By this means they talked together across a whole continent, and conveyed their thoughts to one another in an instant over cities and mountains, seas or deserts."

It will be seen how close is the description of this dial instrument to the A B C telegraph of Wheatstone which, until it was superseded by the telegraph, was in common use in many offices. But as there is no mention of any conducting wires between the two friends in communication, we are justified in regarding this as being prophetical of the more recent invention of Marconi.

Roger Bacon (1214-94) may have foreseen the possibility of making dynamite and other powerful explosives when he wrote the following words:

"A small portion of matter, about the size of the thumb, properly disposed, will make a tremendous sound and coruscation, by which cities and armies might be destroyed." But he does not go so far as to hint that it would ever become possible to throw small parcels of explosive matter upon a doomed place from a distance of seven miles or more, a terrible example of the power of propellants which was witnessed in the war in the Far East

The torpedo was very well described by Ben Jonson three hundred years ago, as the following bit of dialogue, taken from his "Staple of News," produced in 1625, will show:

"Barber. They write here of one Cornelius-son hath made the Hollanders an invisible eel to swim the haven at Dunkirk and sink all the shipping there

"Pennyboy But how is't done?

"Cymbal I'll show you, sir. It is an automon, runs under water, with a smug nose, and has a nimble tail made like an auger, with which tail she wriggles betwixt the coats (ribs) of a ship and sinks it straight.

"Pennyboy A most brave device to murder their flat bottoms."

No doubt, however, can be entertained regarding the reality of the various devices described and illustrated in the work by Hero of Alexandria, who flourished about 100 B C In this book may be found the prototype of the steam turbine, the form of engine that has come to the front within the last few years.

Turning over the pages of Heron's work, we are reminded that the slot machines which seem to us moderns such a new way of dispensing small articles are by no means new in principle Here a machine is described and figured which is provided with a slot, the dropping of a coin within which will cause a measured quantity of the liquid to flow out

It has been contended that a strange foreshadowing of the X-rays is to be found in a book by Dr. Andrew Blair, entitled "Annals of the Twenty ninth Century." The date of the work is not given, but the prediction, if it may be called such, runs as follows

"I perceived the Secundines could not only make glass and stones and all inorganic substances malleable, but possessed a power unrevealed by man of making them transparent. I was shown animals upon which the youths were taught zoo ogy and comparative anatomy, in some of which the skin was like a glass case showing beneath the working of the muscles In others the skin and muscles were pellucid, showing the circulatory system In others all was pellucid save the bones, with the view of their being subservient to the study of osteology."

When the X-rays were first detected by Prof Rontgen by their action upon a fluorescent screen and upon a photographic dry plate, the newspaper scribes gave the discovery the erroneous title "the new photography," quite ignorant of the fact that the dry plate was no more than a recorder of the phenomenon Strangely enough, what we may call the "old photography," by which is meant the usual process with camera and lens, was the subject of prophecy many years ago. This is perhaps not so remarkable as the instances of prediction already given; for although the invention of the *camera obscura* is commonly attributed to Baptista Porta in the sixteenth century, its principle was well understood many hundred years before his time. And we may feel confident that many must have dreamed of the possibility of making the images formed by the sun take a more permanent form. Especially would this be the case after Scheele, the Swedish chemist, had shown in the eighteenth century that silver chloride would darken under the action of light. La Fontaine, who died long before Scheele was born, gives in one of his fables a method of picture-making which may be regarded as foreshadowing the beautiful art that is now of service to mankind in so many different ways. It occurs under the title "Voyage Supposé," and a description runs as follows:



The Scientific American had two subscribers in a small town in which I lived 30 years ago.

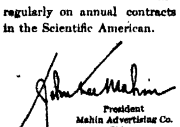
My father was postmaster and I was able to know the number of general publications coming through the mails. I was especially interested in this information because I was business manager of a daily and weekly newspaper published in the same city.

In developing our printing business I was confronted with buying an electric motor. I had no way of determining what I ought to have and consulted with the two men who in that locality had the reputation of being authorities on mechanical matters

It may have been a coincidence, but I prefer to believe it was a logical sequence that the two men who were generally consulted in the purchase of new machinery by city and county officials and by citizens generally were the two subscribers to the Scientific American.

As I spent several thousand dollars on their advice, I can truthfully bear testimony to the influence of the Scientific American beyond the direct contact with its subscribers.

It is a matter of conviction with me when I urge manufacturers of all kinds of mechanical devices to advertise regularly on annual contracts in the Scientific American.



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"There was no painter in that country; but if anybody wished to have the portrait of a friend, of a picture, a beautiful landscape, or of any other object, water was placed in great basins of gold or silver, and then the object desired to be painted was placed in front of that water. After a while the water froze and became a glass mirror, on which an ineffaceable image remained."

Welding vs. Soldering

By Charles Keyes

IN following the simple law of physics, that a thin piece of metal will melt sooner than a thicker one, we have the solution of welding metals of the same degree of purity In making a ring or band, for example, after approximating the divided ends, place in the joint a piece of the same metal, very much thinner—the thickness or thinness to be decided according to the relative states, the piece usually being about one-eighth or one-twelfth the thickness of the piece to be soldered or welded. The thin piece should be placed in the joint so that it projects on the upper or outer side slightly more than on the inner or under side and also extends beyond the joint all around After the pieces have been properly fluxed, they should be heated—better by a blow-pipe Care should be taken that they be heated all together, not projecting the flame upon the thin piece until the whole is heated almost to melting point

This method is especially useful for dentists in crown and bridge work, and it may also be applied in many arts and industries, such as making brass and wrought iron pipes, etc

In dentistry, for instance, in soldering the cap to the band, in making a crown, if an abutment, use a piece of gold one half the thickness of the band, letting it project around the edge of the band—the circumference being about one-sixth larger than that of the band—then press it down to fit perfectly, having fluxed it beforehand, and follow the edge all the way around with the blow-pipe until it melts

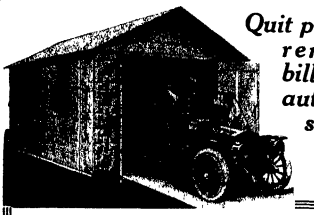
In soldering a cap on an ordinary gold crown, after the band and cap are fitted accurately, place on one side a small piece of, say number sixty, gold foil, flux well, see that its position is correct, then direct the blow-pipe on the piece of projecting foil until the joint is fastened Thus you will have the two parts accurately adjusted and fixed Now take another piece of, say number sixty, foil, large enough to project about one-sixth of its size around the circumference of the crown, cut out a little piece from the center, slip it between the band and crown, cutting out enough to fit accurately around the part attached, flux well, adjust the cap and band, and proceed as in the previous instance. The many applications this may have in jewelry work will be readily understood

In brass, or the noble metals, the procedure is much the same In welding iron, the process is very similar also. For instance, in mending a cracked cast iron cylinder, saw the crack, or file it, to its full extent, making the crack not too wide, then fit accurately a clean piece of thin wrought iron sheet in the joint, allowing it to project beyond all the extent of the crack in the same proportion as in the gold work Heat well, and with the arc melt it to its place

From the above one may see the many uses this method may have, each industry working out its own application

Starch Without Photosynthesis

PLANTS containing the green coloring matter characteristic of grass and leaves obtain their carbon food by the process of decomposing the carbon-dioxide of the air and recombining the carbon with the elements of water into sugars and starches It has been supposed that all starch is a product of this photosynthetic process. L. Caillatet reported to the Academy of Science of Paris the results of some experiments which would indicate that green plants are capable of utilizing as a source of carbon the remains of plant and animal tissues usually found in the soil. His experiments were conducted with ferns of the genus *Adiantum* and consisted in growing specimens in clean quarts sand



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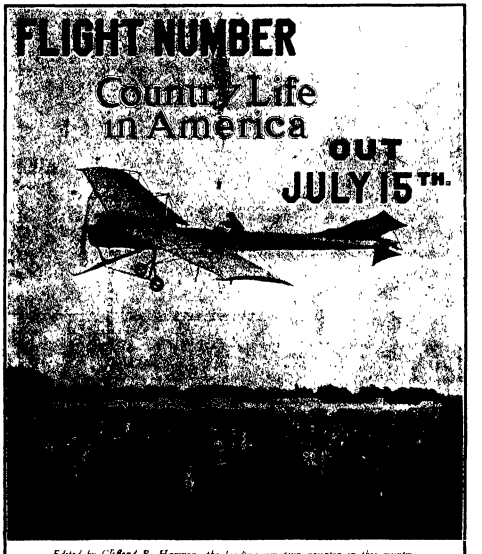
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and others in normal soil. He found that the fern could utilize now the carbon of the air and at other times the carbon of the soil or both simultaneously. The variation seemed to depend chiefly on the intensity of the illumination. Specimens in the sand supplied with suitable inorganic food and water did not grow under conditions of lighting identical with those that normally obtain in the plant's natural habitat; under the same conditions the specimens in soil containing organic debris grew very rapidly With stronger illumination there is more dependence upon atmospheric carbon.

Influence of Manganese on Fermentation

At a recent meeting of the Academy of Science of Paris, E. Kayser reported some interesting experiments with extracts of beer yeast. He had previously found that the presence of manganese salts exercised a favorable action upon the alcoholic fermentation of brewer's yeast increasing the yield of alcohol. He has now tried similar experiments with the juices of the yeast obtained by drying, pulverizing and extracting. He used phosphates and nitrates of manganese and potassium in comparative fermentations and found constant differences in favor of the manganese.

Important factors in determining the activity of the extract are the temperature of the maceration and the condition of the yeast at the time of drying For example, yeast that had been allowed to stand for some time gave juices of variable activity; the best results were obtained from yeasts that had stood from 35 to 40 hours in about 77 deg F Such yeasts macerated in three parts of water gave juices which, when mixed after filtering with 60 per cent of their weight of sugar, liberated gas within five minutes.

A Scientist's "Who's Who"

THE need of a book of reference containing the names, appointments and achievements of the world's foremost scientists has long been felt in learned circles. Messrs J & A. Churchill have in preparation a new annual which is designed to meet this want. It will be called "Who's Who in Science" and is to be edited by Mr H. H. Stephenson.

Schedules are now being addressed to the scientists whose names may appear, and it is hoped that they will assist the publication by filling in and returning the forms to 7, Great Marlborough Street, London, W., as soon as possible.

For enabling scientists to communicate with each other all the world over, and for giving a rapid summary of the achievements and careers of great men the new annual should prove itself indispensable.

Writing to the publishers, Sir E Ray Lankester, K. C B, F. R. S., says: "I feel sure that your new publication will be a great convenience to all who are engaged in scientific work and in literature connected with it. I wish you every success in this new enterprise."

Variations of Alpine Glaciers

THE curves of variation of glaciers which are collected in the Alpine Museum in Berne show, according to Prof. Brueckner, that the 26 great glaciers of Switzerland which were very extensive at the beginning of the 19th century, thereafter receded at first slowly and then more rapidly, until the close of the century. The course of recession was interrupted, about the middle of the century, by a brief advance, in which only two glaciers exceeded the limits that bounded them at the commencement of the century. The glaciers showed a second slight advance between 1890 and 1895.

Although the curves of the various glaciers are similar in general, each exhibits well marked peculiarities, which make it difficult to trace any connection between climatic changes and fluctuations in glaciation. The problem of the glaciers is still involved in obscurity and much patient research will be required to effect its solution.

Science

Detecting Fire Damp by Miners' Safety Lamps.—At the recent soirée of the Royal Society, Sir Henry Cunynghame and Prof. Cadman exhibited a contrivance fitted to miners' safety lamps for the detection of fire damp. The contrivance consists of a small piece of asbestos soaked in carbonate of soda, which can, at will, be introduced into the flame of the lamp without the necessity of lowering it. The presence of small percentages of gas is immediately indicated by the appearance of an orange-colored cap of the same character as appears when a wire, charged with soda, is introduced into a Bunsen gas flame.

Life-rings on a Mountain.—An extraordinary example of the way in which a mountain may afford on a small scale an image of the earth's climates, arranged in successively higher circles, has been found in the San Francisco peaks. These ancient volcanoes rise out of a plateau having a mean elevation of 7,000 feet above sea level. The peaks are encircled with zones of vegetation, which run almost like contour lines around them. Between 6,500 and 8,500 feet the yellow pine is the dominant tree. From 8,500 to 10,300 feet the Douglas fir, the silver fir, the cork fir, and the aspen share the available ground. Between 10,300 and 11,500 feet the Engelmann spruce and the fox-tail pine take possession, and ascend to the tree limit.

Radium in Medicine.—According to experiments made by Prof. Danne, of Mme. Curie's laboratory, and other scientists, radium can be introduced into the tissues by what resembles an electrolytic method. Rabbits and cows, also persons, were operated on, and the radium passed into the tissues without injury to the skin. The penetration is independent of the blood circulation and goes in to some depth, and the effect lasts for quite a time, so that cures can be made in this way. Some of the curative effects of the radium were quite remarkable, as was brought out by Dr. Haret at a recent meeting of the Academie des Sciences.

Vulcanological Studies in Naples.—The Italian government has appointed Prof Giuseppe Mercalli director of the Vesuvius Observatory, and has granted him the sum of $10,000 to rehabilitate the equipment of that institution. At the death of Prof. Matteucci, the late director, it was found that the *matériel* of the observatory had fallen into a deplorable state of inefficiency; hardly an instrument was in working order. The importance of this institution is likely to be overshadowed shortly by the establishment in Naples of an International Institute of Vulcanology. This project, which was originated by Dr Immanuel Friedländer, and which had the hearty indorsement of the recent international geological congress at Stockholm, contemplates an original outlay of $300,000, and an annual expense of $10,000 A good start has been made toward securing the necessary subscriptions.

The International Congress of Applied Chemistry.—President Taft has appointed the official representatives of the government on the organizing committee of the International Congress of Applied Chemistry. The representative from the Patent Office is Dr. George S. Ely of the chemical division The Eighth International Congress of Applied Chemistry will hold its opening meeting in Washington September 4th, 1912, and other meetings, business and scientific, will be held in New York beginning Friday, September 6th, 1912, and ending Friday, September 13th, 1912. The Congress will meet in the United States in response to an invitation extended by the President by authority of a joint resolution of Congress on March 4th, 1909, at the instance of the representation of more than four thousand American chemists, the invitation being extended to the Seventh International Congress in London June 2nd, 1909, by the Hon. Whitelaw Reid, ambassador. The official representatives appointed by the President includes also Dr. H. W. Wiley of the Bureau of Chemistry; Dr. C. F. Langworthy of the Office of Experiment Stations of the Agricultural Department, and many well-known scientists of the country.

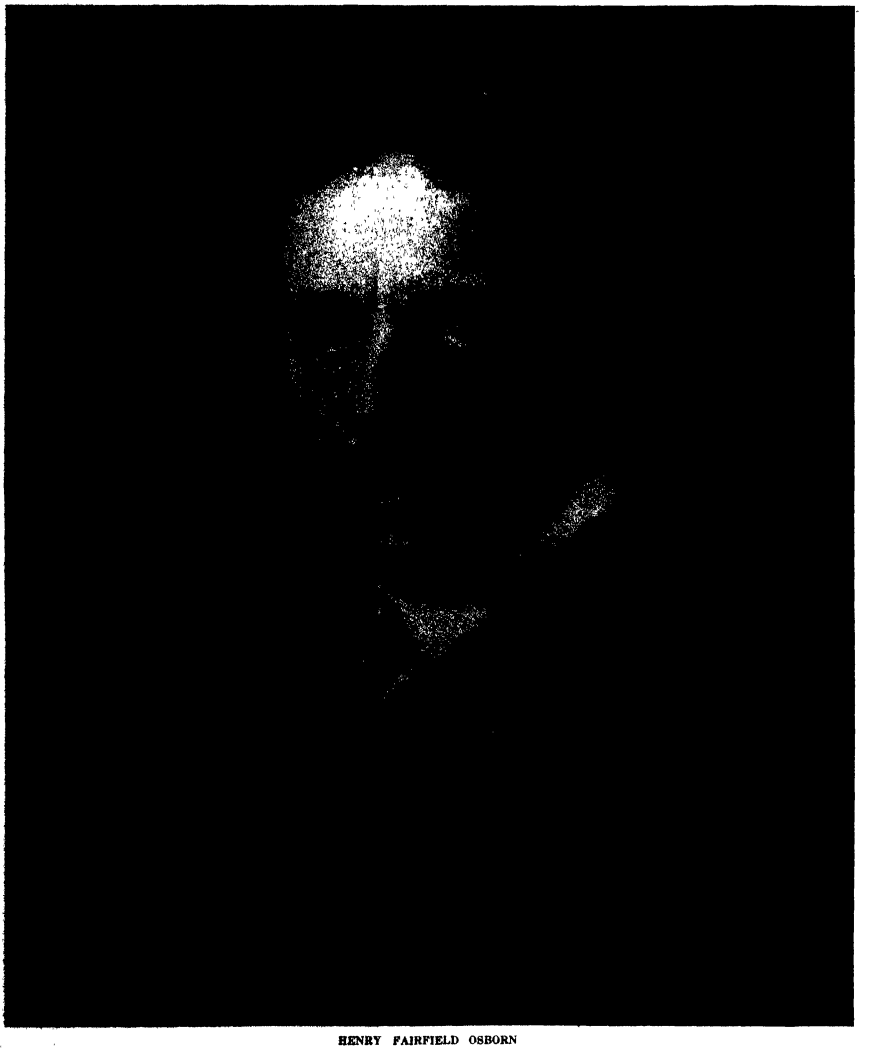
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HENRY FAIRFIELD OSBORN

President of the American Museum of Natural History and America's foremost authority on fossils.—[See page 79.]

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The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are shown the articles stand and the facts entitle the contributions will receive special attention. Accepted articles will be paid for at regular space rate.

The purpose of this journal is to record accurately and in simple terms, the world's progress in scientific knowledge and industrial achievement. It seeks to present this information in a form so readable and readily understood, as to set forth and emphasize the inherent charm and fascination of science.

An Imminent Railroad Danger

WE are so much accustomed to speak of the perfection of the track and equipment of our leading railroads that the occurrence of such a disaster as happened last week at Bridgeport to the Washington express fills us with dismay and raises a very grave doubt as to whether we have even yet discovered how to make the modern high-speed train a perfectly safe means of travel.

Broadly speaking, railroad accidents are due to failure of either the physical or the human element—the roadbed and rolling stock or the operating employee. The Bridgeport accident, according to the statement given out by the officials of the road, was due immediately to the failure of the engineer in charge of the train, remotely, however, it must be regarded as due to track conditions, which, had they been other than they were, would have prevented the accident in spite of the carelessness of the employee.

The line of the New Haven Railroad at the scene of the accident is a four-track road, the outer tracks of which are mainly reserved for local or suburban service, and the two inside tracks for express service. At the stations the express trains, unless express platforms are provided, make use of the local platforms, crossing over for this purpose from the express to the local tracks at a point some distance back from the station. It is customary for the expresses to slow down on approaching the switch of the cross-over, and it seems that, in the case in question, the rules of the New Haven road call for a reduction of speed to fifteen miles an hour. The officials of the road have stated that the engineer ran his heavy express train over the switch at a speed that was nearly sixty miles an hour.

Now, at any such speed as this, the inertia of the engine was too great for the flanges of the wheels to do their work effectively in holding the train on the track. It mounted the rails and plunged down the embankment, with the result that some fourteen people were killed and half a hundred wounded.

Unquestionably in this day of high-class track and rolling stock the most prolific source of accidents on railroads is the failure of the human element. For some reason which will never be explained, since the man is dead, the engineer either failed to observe or to obey both the signals and the speed regulation. It was hot weather and he had gone through a heavy day's work—possibly he was in a state of physical weariness which caused a temporary mental lapse. Whatever the explanation, the fact remains that we have here one more railroad disaster attributable to human failure, and the question immediately presents itself, "Would it not be possible to arrange this matter of cross-overs or turn-outs for fast trains, so that the safety of the train would be automatically taken care of, and not be left dependent on the mental and physical condition of the engineer?"

The answer to this question is that it would be entirely possible, in the great majority of cases, to so construct these cross-overs that even if regulations as to slow running were overlooked or disobeyed, an express train would run through from one track to the other without any serious risk of derailment. This could be done by making the cross-over extend over a greater distance, measured along the axis of the roadbed, and making the angle of the frogs, switches, etc., as small as is compatible with structural requirements. It would be entirely possible to lay out the track with switches and curves so easy that if a heavy express train disobeyed its orders (say for a 30-mile speed at the cross-over), and swept over it at a speed of 60 miles an hour, it could do so without any grave risk of derailment.

Now we understand that at least one of our leading railroads has already adopted this plan. Its cross-overs are so gradual and the length of the cross-over between switches is so great, that the trains are swung from one track to the other, even when they are running at high speed, at the will of the signal man, and without the imposition of any speed reduction upon the engineer. These are the ideal conditions; for construction of this character eliminates entirely a risk of operation, whose magnitude is only appreciated in the presence of such a frightful disaster as that which recently occurred near Bridgeport.

We commend this most important subject to the joint consideration of the Interstate Railroad Commission, and of the maintenance of way engineers of our railroads. The lengthening out of cross-overs would be one more step in the elimination of the human element as a predisposing cause for accidents, and therefore it would be consistent with the policy which has brought about the introduction of the automatic block signal system and similar safety appliances for the protection of life in railroad travel.

Causes of Aviation Accidents

ACCORDING to the conclusions of Lieut.-Col. Bouttieaux, who has just prepared a careful report upon the principal causes of serious aviation accidents, these may be divided into four classes, due respectively to faults of construction, mistakes of the pilot, state of the weather, and finally, either to the fault of the public or to one of a variety of special or ill-determined factors.

Up to the first of the present year, there is a record of 31 fatal accidents, costing the lives of 84 persons. Of these, twice as many took place in 1910 as in 1909, but if we take into account the fact that the number of aviators had been quintupled, the proportion descends to 40 per cent of the previous year. Seventeen of these accidents were due to bad construction, 2 to atmospheric perturbations, 9 to faults of the pilot, and 3 to other causes.

The classification of *simple* accidents, i. e., those without tragic results, gives in the above-mentioned classes the figures 26, 27, 33, and 81. Hence, in the total, 29 per cent of these accidents are imputable to the construction and 27 to the piloting of the machines.

The following summary of the accidents per year is illuminating: First, imperfect construction was responsible for 14 accidents, 1 of which was fatal, in 1909, and in 1910, for 29 accidents, 16 of which were fatal. Second, errors of pilot caused 21 accidents (1 fatal) in 1909, and 21 accidents in 1910, of which 8 were fatal. Third, atmospheric disturbances caused 4 accidents (none fatal) in 1909, and 25 (2 fatal) in 1910. Fourth, imprudences of spectators or aviators and other special or ill-determined causes were responsible for 8 accidents (1 fatal), in 1909, and for 26 accidents in 1910, of which 2 were fatal. The total number of accidents in 1909 was 47, and in 1910 there were 101 accidents.

The increase of accidents due to atmospheric conditions is explained largely by the fact that in 1909 aviators dared not risk their lives in all sorts of weather, as they began to do later, while the greatly increased number of aviation meets had as a corollary an increase in the number of accidents of class 4, caused by faults of spectators or collisions in a restricted landing place.

Faults of construction may be divided into those which may be ascribed to the principle of the machine, and those due to imperfect execution of a plan theoretically perfect. The proportion of the first to the second is as 2 to 43, which does honor to the conception of the aeroplane.

Among accidents of construction, those involving the wings amount to 18, and they frequently were due to a rupture at the line of union with the fuselage, especially in monoplanes. The results are among the most terrible, with 11 cases fatal, and the others very serious. Those ascribable to the motor or controls were 17 in number, of which 5 were fatal. The propeller entered into 6 accidents, in 5 of which it was of metal.

Errors of pilotage brought about 42 accidents, of which 9 were fatal. Among these, faulty turns entered into 24, of which 3 were fatal, while the manner of landing occasioned 8, of which 5 were fatal.

Too sudden an ascent, causing a loss of sustaining power to the machine, in consequence of the insufficient power of the motor, caused 9 accidents, with 1 fatality.

Of reciprocal injuries between aviators, 5 resulted from too close a proximity of passage and the resulting air "wash."

There is nothing to show whether biplane or monoplane is the more subject to accidents, for if more fell to the share of the former, that is due, for the moment at least, to the circumstance of their majority; the percentage was about the same.

How may these causes of accident be overcome? The author of the report advises, in the first place, the use by pilots of helmets, belts, and other safety devices in the shape of garments, which will be efficacious in cases of moderate fall. For machines he recommends shock absorbers and especially a lightly-constructed prow, the breaking of which would serve to deaden the shock. It would, in fact, be desirable that special experiments should be made with reference to the localization of a weak point upon which the initial effect of a shock would be expended, just as in every electric circuit a fuse is introduced at some point where will be localized the effects of a chance excess of voltage.

As for parachutes, their tests have thus far been too few to be commented upon.

Dangers from faulty construction may be minimized by demanding a certificate of navigability and enforcing certain requirements of construction with reference to the choice of materials and the strengthening of the controls.

For the pilot the addition of automatic stabilizing apparatus would be desirable; but these must be practical and efficacious, which is at present only a hope. Equally useful would be instruments indicating loss of speed, exaggerated incidence, lateral sliding toward the center in turning, etc.

The education of the pilot, improving progressively, on his part, will tend to eliminate risks of aviation, while greater difficulty in obtaining a pilot's license will, to some extent, limit accidents to the period of apprenticeship. Casualties due to meteorological conditions are more difficult to avoid, if not impossible. The best remedy would be a deeper knowledge of meteorology and topography, and the making of appropriate topographical maps will contribute to this end. The education of crowds, as well as fewer aviation meets, will diminish the risks occasioned by them.

The conclusions of the report are very encouraging. Bouttieaux proves that the increase of accidents, so alarming at the first view, arises from the great progress made by aviation, and this in spite of the indisputably rudimentary character of several of the machines. The improvement of these, whose era is just dawning, will render them steadily safer and more manageable, till a reasonable degree of safety is assured.

The Albedo of Clouds

THE albedo of clouds varies between wide limits, but was formerly assumed to average about 0.75; i. e., the upper surface of the clouds was supposed to reflect about 75 per cent of the incident sunlight. The albedo of white paper is 0.70; of new-fallen snow 0.78. The first attempts to measure accurately the albedo of a layer of clouds seen beneath an observer posted on the top of a mountain were those made by Abbot and Fowle on Mount Wilson in 1906, and gave an average of 0.65, but this result was later found to be doubtful, owing to errors in reduction. Within the past few months this problem, which has such important bearings upon the physics of the earth's atmosphere, has been taken up in Germany by Messrs. Stuchtey and Wegener, who made numerous measurements with a specially constructed albedometer in the course of several balloon voyages. They found the following values, which have been corrected by eliminating the general radiation of the sky, and refer only to the proportion of direct sunlight reflected: Lower stratus clouds, 0.54; higher stratus, 0.76; cumulus, 0.67. They also measured the albedo of the earth's surface as seen from altitudes between 600 and 1,650 meters. The albedo of open fields was found to average 0.15; of woods, 0.06.

The Winning of the International Aviation Trophy

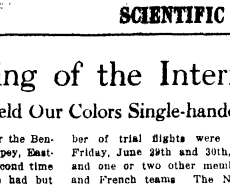
How Weymann Upheld Our Colors Single-handed and Won the World's Greatest Speed Event

THE third international aeroplane race for the Bennett trophy was held at the Isle of Sheppey, Eastchurch, England, on July 1st, and for the second time America came out victorious, although she had but one representative against the three each of France and England. After attempting to get the Wrights and Glenn H. Curtiss to represent America this year in the race, the Aero Club officials finally secured Charles T. Weymann, the young aviator who has made a name for himself in aviation abroad, to endeavor to bring back the cup to America. It was first won in 1909 by Glenn Curtiss, who went to France with his own machine and beat Blériot with his fast monoplane. Last October, at Belmont Park, Grahame-White won the race on account of an accident to Leblanc, Blériot's chief pilot. The Englishman won on a Blériot monoplane, as there was no rule requiring the machine to be built in the country which it represented. The Nieuport monoplane, during the past six months, has proved itself to be one of the fastest and one of the most efficient aeroplanes; and as there was no rule forbidding it, Mr. Weymann decided to use one of these machines, which he has flown considerably of late. He was obliged to abandon the Paris-London-Paris circuit race, in which he was among the leaders, at Utrecht, in order to fly in the cup race; but the result of the race amply justified him in doing this.

For the past eight or nine months M. Blériot has been experimenting upon speed machines. Several months ago we gave information about his latest speed monoplane, which had a peculiar shape of wing and was fitted with a powerful motor. Blériot experimented with a 140-horse-power 14-cylinder Gnome motor, and it was thought that the machine for the race would be equipped with one of these engines, as well as with the peculiar shape of wing, with flexible rear edge, with which he had had his greatest success. When M. Leblanc appeared at Eastchurch with a machine having wings of only one meter width and a total spread of nine meters, or, in other words, nine square meters (96.876 square feet) surface, and fitted with a 100-horse-power Gnome motor only, he sprang a surprise upon aviation enthusiasts, who doubted whether he could win the race with such a diminutive machine, equipped with no more powerful motor than he used last year. The Nieuport monoplanes, however, had only 70-horse-power motors, and consid erably larger wings. One of them, driven by Chevalier (who was the third man on the French team), had only a 50-horse-power Nieuport motor. Nieuport himself drove a 70-horse power Gnome-engined machine, as did also Charles T. Weymann.

The English team was made up of G. Hamel on a 100-hörse-power Blériot, which was practically a duplicate of Leblanc's; Alec Ogilvie, on a baby Wright fitted with a 50-horse-power N. E. C. two-cycle motor; and Graham Gilmour, on a Bristol monoplane. As reserves, England had Messrs. J. Radley, J. Valentine, and O. C. Morrison. Mr. Radley flew in the Bennett race last year, as did also Mr. Ogilvie. The latter completed the race last year on a Wright biplane, and secured third place. This year he used an English-built Wright machine constructed under the supervision of Wilbur Wright, and fitted with a four-cylinder V-type two-cycle motor, recently illustrated in our columns.

The reserve members of the French team consisted of Aubrun, who flies a Deperdussin monoplane; Vedrines, the Morane pilot; and Gibert, with his R. E. P. The Frenchmen had on hand at the time of the race four extra Nieuport monoplanes, three Blériots, two Deperdussins, and one R. E. P. A number of trial flights were made on Thursday and Friday, June 29th and 30th, by Weymann, Nieuport, and one or two other members of both the English and French teams. The Nieuport monoplane was booked as the winner, and it was thought that Weymann stood an excellent chance. July 1st dawned clear and pleasant, although there was considerable wind in the morning and early afternoon. The race was scheduled to start eight hours before sundown, but the flying did not begin until about 3 P. M., at which time the wind was blowing at less than twenty miles an hour. The course was six kilometers (3.72 miles) in circumference, and was over level, smooth ground. Its only disadvantage was its proximity to the sea, which, of course, was responsible for the rather stiff breeze that blew some of the time.



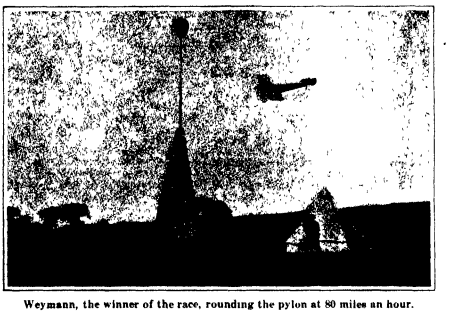
Oglivie rounding the pylon on his baby Wright racer.

Note the sharp angle at which the aviator is ascending. This is to allow for dropping of the machine in making a turn.



Leblanc doing 75 miles an hour on the straightaway.

Note the narrow wings and the finely tapering lines of the body of his high-powered machine.



Weymann, the winner of the race, rounding the pylon at 80 miles an hour.

The fuselage shape of the body (which is entirely covered with cloth) is well shown in this picture. It is to this form that the greatly diminished head resistance is largely due.



Wreck of Hamel's Blériot. The aviator escaped uninjured.

The 14-cylinder, 100-horse-power Gnome motor is clearly seen, as is also the specially tapered fuselage used on this racing monoplane.

SCENES AT THE GREAT RACE.

Gustave Hamel, the English aviator, was the first to start, which he did at 4 P. M. It was thought that he would do well, as he had made an excellent showing in the morning while practising. Instead, he banked too much on making the turn on his first round of the course and his machine slid sideways to the ground, and was smashed to pieces. The aviator luckily escaped without any serious injuries. Shortly after Hamel's accident, Weymann started in his Nieuport monoplane. He rose to the height of 100 yards or so, which elevation he maintained through out the entire twenty-five circuits of the course. He covered the first five circuits (30 kilometers) in 14 00 2/5. Chevalier was the first Frenchman to start. He flew fairly well in his low-powered Nieuport, but alighted after completing ten laps, and did not finish the race.

As Gilmour withdrew, England's only remaining representative was Ogilvie, who flew his baby Wright in excellent fashion, though he was unable to make anything like the speed of the Nieuport or Blériot monoplane. Nieuport covered the first five circuits in 14 46, whereas Ogilvie required 21 45 to fly the same distance (18 miles). Leblanc was the last to ascend. He covered the first circuit in practically the same time as Nieuport, and at the end of ten laps, which he covered in 29 29 4/5 he was only four seconds ahead. He was still ahead of his compatriot at the end of fifteen laps, and although he succeeded in the end in beating the latter by 57 seconds, he failed to beat Weymann by 2 minutes 24/5 seconds.

The time of the winner in the race was one hour, eleven minutes, thirty-six and one-fifth seconds, which corresponds to an average speed of 78.1 miles an hour. Leblanc was second in 1 12 40 1/5—an average speed of 77.91 miles an hour. The third place went to Nieuport in 1 14 37 3/5 (74.94 miles an hour), and fourth to Ogilvie, in 1 49 10 2/5 (71.22 miles an hour). Chevalier's time for his ten laps was 37 37 1/5. This corresponds to an average speed of 59.3 miles an hour, which is very good, considering the low power of his machine.

The winning of the race by America should serve to stimulate aviation in this country greatly, especially since next year the rules will probably be changed so that the machine and pilot must both be the production of the country which they represent. As speed is the desideratum of the racing aeroplane, and the thing for which it exists, we believe that if our inventors can develop the speediest and at the same time the safest, flying machines they will again cause America to lead the world in aviation, just as she did at the start.

South Sea Swells

WE all remember with what frequency in the old narratives of experiences in the South Seas reference is made to the heavy swells of the ocean which impressed the navigators with the idea of their remoteness from land.

The great size of the sea waves in high Southern latitudes has been explained by the fact that south of the Cape of Good Hope and Cape Horn there is neither windward nor leeward shore, and the prevailing wind in all longitudes is westerly. Thus when a west wind springs up it finds a long westerly swell, the effect of a previous wind, still running. The new-born wind increases the steepness of this swell, and so forms majestic storm waves which sometimes attain a length of 1,200 feet from crest to crest. The average height attained by sea waves in feet is about half the velocity of the wind in miles per hour.

The Beacon Hill Tunnel

How a Half-mile of the Boston Subway Was Built in Tunnel

By G. D. Emerson

THE most recent underground construction in the Boston district for the use of street railway traffic is the tunnel through Beacon Hill, which is now nearing completion. This tunnel, which is a little less than half a mile in length, does not follow the street lines, but runs through the middle of Beacon Hill in a general northwesterly and southeasterly direction, connecting at its northwesterly end with an elevated structure which will cross the Cambridge bridge over the Charles River, and at its southeasterly end terminates at present in a station beneath Boston Common, under the Park Street station of the Tremont Street subway. The bottom of the tunnel, at the deepest point is about one hundred feet below the top of the hill. This tunnel forms the Boston end of the new subway lines connecting Harvard Square, Cambridge, with the business section of Boston.

Beacon Hill is presumably a glacial formation, and is composed in general of a very hard mixture of blue and yellow clay and sand, together with numerous small stones and a few large boulders. Irregular streaks and pockets of sand, some containing water, were frequently encountered during the progress of the work. No serious difficulty resulted, however, from the ground-water, and this, together with the hardness of the ground, made it unnecessary to do any of the work in compressed air, although there was a provision in the contract for the work for doing so in case of necessity. At one point, about sixty-five or seventy feet below the surface, some worn fragments of clam shells were found imbedded in the hard blue clay.

The general method of tunneling adopted for this work was by means of a roof-shield, which is quite similar in character to the shields used in the tunnels already constructed in this vicinity. The Tremont Street tunnel of the original subway, the East Boston tunnel and the Dana Hill tunnel of the Cambridge subway.

This roof shield is essentially a semi-circular steel frame weighing about sixty-five tons, the diameter of which is equal to the outside width of the tunnel, which is thirty-two feet four inches. Its function is to support the earth above the roof of the tunnel temporarily while the permanent concrete tunnel arch is being built below.

The first operation in this method of tunneling is to dig two small pilot-tunnels—or so-called side-wall drifts. These drifts are about nine feet square, the roof and sides being timbered and they are located at the bottom outside corners of the tunnel section. As fast as they are excavated, the lower part of the concrete side wall of the tunnel is built in them. They are kept from one hundred and fifty to two hundred feet in advance of the shield, so that the concrete walls will have sufficient time to harden before the weight of the shield comes on them. The shield, which rests on cast-iron rollers is pushed along on top of these concrete side-walls by means of hydraulic jacks.

The successive operations are as follows: The earth is excavated for two and one-half feet ahead of the shield, which is then shoved forward through this distance by means of the hydraulic jacks before mentioned. A section of the concrete arch two and one half feet long is then built under the overhanging steel plates at the rear of the shield. The soft concrete is placed on temporary steel centers or supports, which are removed after it has become sufficiently strong. The overhanging plates at the rear of the shield are about one and a quarter inches thick, and when the shield is shoved forward it leaves an annular space of that thickness between the concrete arch and the earth. This space is filled as soon as practicable by pumping in liquid cement grout. In actual work, the operations of excavating ahead and putting in concrete at the rear of the shield are carried on simultaneously. This cycle, which takes about five or six hours, is repeated continuously.

A rear view of the lower part of the shield in actual operation, and showing some of the temporary steel centering immediately behind it, is shown herewith. The upper half of the shield in working condition is also illustrated. As fast as the excavation is completed, and the concrete arch is in place, the concrete bottom is put in.

All machinery for operating the shield and hauling the working-cars in the tunnel is run by compressed air furnished by a compressor plant located near the mouth of the tunnel. As stated above, the shield is shoved ahead by hydraulic jacks, of which there are fourteen, spaced equally around the circumference of the shield. These jacks have plungers eight inches in diameter and work under a maximum pressure of four thousand pounds to the square inch, which gives a maximum pushing force of nearly one hundred tons for each jack, or about one thousand four hundred tons for the whole shield. The jack-cylinders are bolted to the frame-work of the shield and the plungers push against lines of cast-iron rods which are imbedded in the concrete arch. The water, under pressure, for operating the jacks, is furnished by two pumps which are run by compressed air.

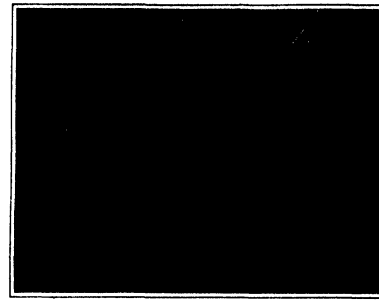
Economy in this kind of construction depends to a large extent upon systematizing and specializing the work. Thus, several different gangs of men do the excavating in the pilot tunnels and on the shield platforms, others put in the concrete walls in the pilot tunnels and the concrete arches at the back of the shield, and still others attend to setting up and taking down the temporary concrete supports, handle the cars which bring in fresh concrete and take out the excavated earth, etc. Each of the different operations is repeated continuously so that by proper systematizing the labor becomes very efficient. Most of the work was carried on by two ten-hour shifts per day, the number of men in each shift averaging about one hundred and thirty. The average progress per twenty-four hours was seven and a half feet, and the maximum progress per 24 hours was about nine feet.

The surface of the hill, over the line of the tunnel, is thickly covered with brick buildings from three to six stories in height. The excavation was carried on in such a manner, however, as to avoid any settlement or damage to them.

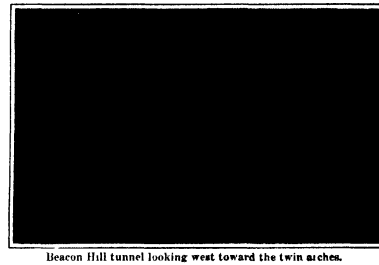
During the course of the work about a dozen old wells that used to furnish the water supply for former residents on Beacon Hill were encountered in the tunnel headings. Some of these old wells were one hundred feet deep and more than a century old, and the hollow pump-logs were still in place, and in fair condition. The first intimation the tunnel workers had of their existence was when the stone lining of the wells fell down into the tunnel when they were reached by the excavations. This resulted in some delays, but no very serious difficulties.

The chief item of interest toward the end of any construction of this sort is where the tunnel "comes out," that is, how close the engineers have been able to run their lines to the theoretical position the tunnel should occupy. Part of this tunnel is on a curve of four-thousand-foot radius, which makes the running of the survey lines somewhat more difficult than if the line were straight. In this particular case the tunnel came out at the final end within less than half an inch of its calculated position.

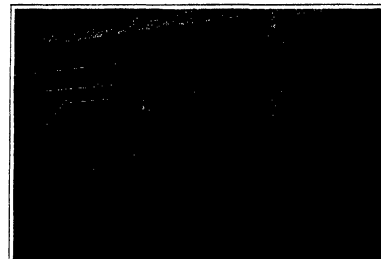
The Beacon Hill Tunnel is being built for the city of Boston by the Boston Transit Commission, and, upon completion, it will be leased to the Boston Elevated Railway Company.



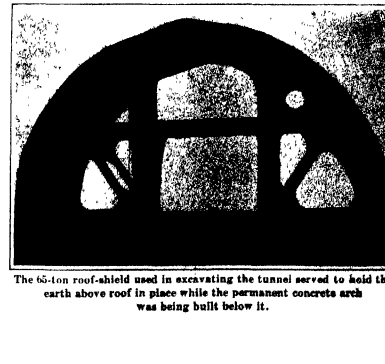
View of steel centers and shield from upper working deck.



Beacon Hill tunnel looking west toward the twin arches.



Rear view of lower part of shield, showing temporary steel centering behind it.



The 65-ton roof-shield used in excavating the tunnel served to hold the earth above roof in place while the permanent concrete arch was being built below it.

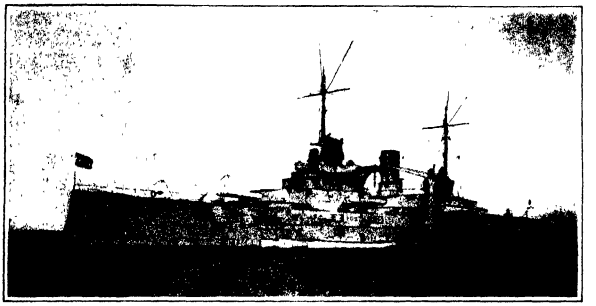
A Comparison of the German and American Navies

Our Great Superiority in Gun-fire Places the United States in the Lead.

By H. D. Brandyce

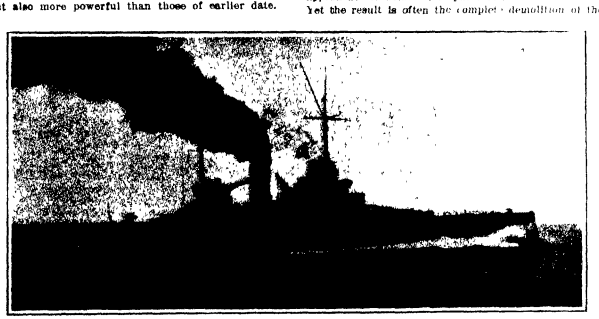
ONE of the most fruitful topics of the day seems to be the phenomenally rapid growth of the German Navy; and the notion is widely held that the Kaiser is adding to his fleet for the purpose of challenging England's age-long supremacy on the sea. Now, whatever may be the Kaiser's idea, such a contingency is not likely to be realized for many years to come, for not only is Germany's naval strength still far inferior to Britain's, but it is at the moment of writing also vastly less than our own.

Until the year 1910 those who made it their business to rank the various fleets of the world had assigned second place to the United States Navy, England holding first position and Germany third, but in the last twelvemonth these critics have seen fit to attribute to Germany a superiority which in our opinion is not borne out by fact. The only fair way to estimate the relative strength of the two navies is to take them ship for ship and compare their respective offensive and defensive qualities. The tonnage method which most naval writers employ is misleading, for it lumps together the armored and unarmored ships, and takes no account of age or design. In this way four unarmored cruisers would equal one battleship and twelve destroyers would rank with one armored cruiser. Obviously the proper means of obtaining relative values is to oppose battleship to battleship, armored cruiser to armored cruiser, as they would presumably line up in actual conflict. And, further, these ships should be as near as possible of equal age, for of course the newer vessels are not only larger but also more powerful than those of earlier date.



Displacement, 18,900 tons. **Speed,** 20 knots. **Coal,** 2,500 tons; **oil,** 300 tons. **Main battery,** twelve 11-inch; **secondary battery,** twelve 6-inch. **Main belt,** 9½ inches; **upper armor,** 5 inches; **turrets,** 9½ inches.

German Dreadnought "Westfalen."



Displacement, 18,800 tons. **Speed,** 20 knots. **Coal,** 2,700 tons; **oil,** 300 tons. **Main battery,** twelve 11-inch; **secondary battery,** twelve 6-inch. **Main belt,** 9½ inches; **upper armor,** 8 inches; **turrets,** 9½ inches.

German Dreadnought "Nassau."

We need only concern ourselves with four classes of ships—battleships and armored cruisers, destroyers and submarines, for the functions of protected cruisers and gunboat are almost negligible from a military point of view, their activities being properly confined to police duty in time of peace, and, in time of war, to scouting and intelligence service. Of the four classes which we shall consider, the battleship is all-important; it takes its place in the forefront of the line of battle, and bears the brunt of the fighting. The armored cruiser is the heavy cavalry of the sea, and but rarely takes its place where the fire is hottest.

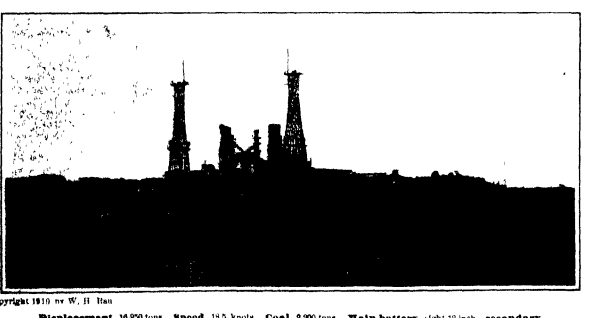
In making comparisons of the ships of these two navies, the dearth of positive information on subjects relating to the efficiency of the personnel of the Kaiser's fleet requires that in all matters dealing with the personal equation the two services be considered on a parity. We know nothing definite of the Germans' proficiency in battle practice or in steaming trials; but we may be quite sure that the thoroughness which is characteristic of their nation has brought these things to a high state of perfection.

But no matter how much they may practise at the targets, they cannot overcome deficiency in materials; inferior guns must give inferior results, for, strange as it may seem, Germany, the home of the Krupps and the Ehrhardts, has at this moment not one gun afloat which can pierce our battleships' side-armor at what we call battle range (8,000 yards)! This is a startling fact, and one which must be of supreme importance in making a fair comparison of the offensive power of the two fleets. In our annual battle practice the battleships commence firing at the targets when they are some 12,500 yards away and their firing time is generally exhausted before they have approached to within 8,000 yards of the canvas screen. Yet the result is often the complete demolition of the target, although the mark is a rectangle less than one-fourth of the area of the broadside of a modern man-of-war.*

Little or nothing is known about the conditions under which the German High Sea Fleet conducts its shooting, but it is highly probable that their ranges are less than ours, for their lighter guns could not hope to score hits at over 10,000 yards, owing to the fact that the high angles at which they must fire at such great distances would tend quickly to impair the accuracy of their aim. Their new 11-inch guns of 45 caliber† with which, by the way, only their dreadnoughts are equipped—have a very high muzzle-velocity (3,250 foot-seconds), but the relative lightness of the shell (.595 pounds against .850 pounds for our twelves) tends to a rapid falling off in velocity at anything above a point-blank range. So that while at 3,000 yards—which is almost point-blank—their armor-piercing shell will penetrate 22 inches of Krupp armor to 20 inches for our 12-inch A. P. shell, at 8,000 yards the penetrations are 8¼ inches and 11 inches respectively. All this means that in case of actual hostilities between Germany and the United States our vessels in the line of battle could fire with effect at the German battleships at ranges at which the latter could not seriously injure the vitals of our men-of-war. Of course they could do great damage to our upper works and lightly protected ends, but in the meantime—and before they could close in—our heavy artillery would presumably have shot their side-armor to pieces and pounded their turrets until they jammed and were incapacitated for further firing. (At the battle of Tsushima the Japanese sank many of the Russian battleships by long-range firing, the impact of the heavy projectiles against the belt-armor tending to fracture the plates and start the seams so that the water entered in sufficient quantities to flood

* The U. S. armored cruiser "Maryland" won the battleship trophy for 1910 by making 40 per cent of hits with her 8-inch guns at 10,000 yards in a heavy sea.

† The word "caliber" is here used to express the length of the gun in terms of the diameter of the bore: thus a 12-inch gun of 45 calibers would have a length from powder chamber to muzzle of 45 feet.



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Displacement, 16,050 tons. **Speed,** 18.5 knots. **Coal,** 2,900 tons. **Main battery,** eight 12-inch; **secondary battery,** twenty-two 5-inch. **Main belt,** 12 inches to 10 inches; **upper side,** 10 inches to 8 inches; **turrets,** 12 inches to 9 inches.

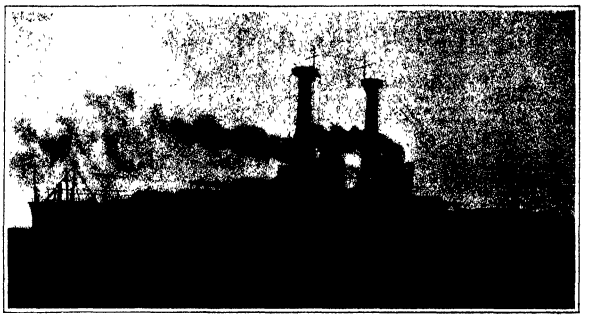
United States Dreadnought "Michigan."

the compartments and ultimately cause the ships to turn turtle.)

In the matter of armor protection there is little to choose between the fleets of the two powers when the ships are compared individually according to date of launch. The same holds true of the relative speeds. In coal supply the Americans have a slight advantage as may be seen in the appended tables.

The twenty-six German ships given in the table have a total displacement of 339,220 tons, an average of 13,047 per ship. This *compares* with a *total* for the Americans of 407,650 tons, and an average of 14,057. Let us now examine somewhat more closely into the guns and armor of the later models—say the fourteen most recent Germans and the twenty newest Americans.

Taking first the four "Westfalens." They carry twelve heavy guns each, but these are so arranged that only eight of them can fire on either broadside. The ten heavy guns of the "Delaware," in pairs in five turrets on the center line, can all fire on either broadside which gives the Yankee dread



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Displacement, 20,300 tons; **Speed,** 21 knots; **Coal,** 2,340 tons; **oil,** 600 tons. **Main battery,** ten 12-inch; **secondary battery,** fourteen 5-inch. **Main belt,** 11 inches; **upper side,** 10 inches to 8 inches; **turret,** 18 inches to 8 inches.

United States "Delaware."

Able to Pierce Inches Krupp at 8000 yds	9 4-in	11 in 10-cal	11 in 45-cal	No. of Ships in Class	Name	Name	No. of Ships in Class	12 in 45-cal†	12 in 40-cal†	13 in 35-cal ("Iowa," 12 in 35-cal.)	Able to Pierce Inches Krupp at 8000 yds
8½			12	14	"Nassau"	"Delaware"	(2)	20			11
						"Michigan"	(2)	16			11
6		10		(10)	Hannover	"Connecticut"	(6)	24			11
						"Idaho"	(2)	8			11
						"Georgia"	(5)		20		8½
						"Maine"	(4)		12		8½
4½	40			(10)	"Kaiser	"Alabama"	(4)			12	6
2½	*8			(2)	Wosrth"	"Kearsarge"	(2)			8	6
2	**11					"Indiana"	(4)			12	6
						"Iowa"	(1)			4	4
	52	10	12					68	32	40	

† Only the main batteries are here shown. * Old 11-in 40-cal. ** Old 11-in 45-cal.

TABLE SHOWING COMPARATIVE OFFENSIVE AND DEFENSIVE POWER OF GERMAN AND AMERICAN CRUISERS

Secondary Battery	Main Battery	Upper Side Main Turret	Main Belt	Coal Supply	Sea Speed	Displacement	Date	Name	Name	Date	Displacement	Sea Speed	Coal Supply	Main Belt	Upper Side Main Turret	Main Battery	Secondary Battery
10 6 in 50-cal	8 11 in 45-cal	4½ in 8 in	6 in		25 to 28	18 700	1909	"Von der Tann"									
16 3 9 in 40-cal	12 8.2 in 45-cal	" 6 in	6 in	2400 & 200 oil	24½	15 500	1908	"Blucher"	"Montana North Carolina" "Tennessee" "Washington"	1904 to 1906	14 500	22	2000	5 in	5 in 9 in -5 in	4 10 in 45-cal	16 6 in. 50-cal 22 3 2in 50-cal
6 6 in 40-cal	8 8.2 in	6 in		2000 & 300 oil	17*	11 600	1906	"Scharnhorst"	"California" "Colorado" "Maryland"	1903 to 1904	14 500	22	2000	6 in	5 in 6½ in to 6 in	4 8 in 45-cal	14 6 in 50-cal
20 3 9 in 45-cal	40-cal	6¾ in	6 in		22 5			"Gneisenau"	"Pennsylvania" "South Dakota" "West Virginia"								20 4 2 in 50-cal
10 6 in 40-cal 14 3 9 in	4 8.2 in 40-cal	4 in 6 in	4 in	1600 1500 & 200 oil	21	9 050	1903 to 1904 1903 to 1904	Roon "Prinz Adalbert" "Friedrich Karl"	"Charleston" "Milwaukee" "St. Louis"	1904 to 1906	9 700	22	1500	4 in	4 in		14 6 in 50-cal 18 8 2 in 50-cal
10 6 in 40-cal 12 4 2 in	2 9 4 in 10-cal	4 in 6 in Nickel Steel	4 in	1500 & 200 oil	20	8 940	1900 to 1902	"Prinz Heinrich"	"Brooklyn"	1895	9 200	21	1650	3 in Harvey	none 8 in	8 8 in 35-cal	12 5 in 40-cal
12 6 in 40-cal 10 4 2 in	9 9 4 in 10-cal	none 8 in Nickel Steel	8 in	1200	18 5	10 700	1897	Furst Bismarck"	New York"	1891	8 200	21	1150	4 in Krupp	none 7 in.	4 8 in 45-cal.	12 5 in 50-cal 8 3 2 in 50-cal
						11 324	Av	10 Ships	15 Ships	Av	12,467						

* Scharnhorst injured 1909 and has been slow ever since.

COMPARATIVE POWER OF GERMAN AND AMERICAN BATTLESHIPS.

Secondary Battery	Main Battery	Upper Side Main Turret	Main Belt	Coal Supply	Sea Speed	Displacement	Date	Name	Name	Date	Displacement	Sea Speed.	Coal Supply	Main Belt	Upper Side Main Turret	Main Battery	Secondary Battery
12 6 in 50-cal	12 11 in 45-cal	8 in 9¾ in	9¾ in	2700 & 200 oil	20	18,500	1908 to 1909	"Nassau" "Westfalen" "Posen" "Rheinland"	"Delaware" "North Dakota"	1908 to 1909	20,800	21	2340 & 600 oil	11 in	10in-8in 12in -8in	10in -12 45-cal	14 5in. 50-cal.
									"South Carolina Michigan Kansas"	1908	16 250	18 5	2200	12in -10in.	10in -8in 12in -8in	8 12in 45-cal	
14 6.7 in 40-cal	4 11 in 40-cal	8 in 11 in	9¾ in	1800 & 200 oil	18	13 200	1905 to 1906	"Hannover" "Pommern" "Schleswig-Holstein" "Schlesien"	"Minnesota" "New Hampshire" "Vermont"	1905 to 1906	16,000	18	2,114	9 in.	7 in 12in -8in	4 12in 45-cal	8 8in 45-cal. 12 7in. 50-cal.
14 6.7 in 40-cal	4 11 in 40-cal	8 in 11 in	9 in	4800 & 200 oil	18	13,200	1904	"Deutschland"	"Idaho" "Mississippi"	1905	13 000	17	1750	9 in	7 in 12in -8in	4 12ip 45-cal	8 8in 45-cal 8 7in 50-cal
14 6.7 in 40-cal	4 11 in 40-cal	8 in 11 in	9 in	1600 & 200 oil	18	14,200	1902 to 1904	"Braunschweig" "Elsass" "Hessen" "Lothringen" "Preussen"	"Connecticut" "Louisiana"	1904	16,000	18	2200	11 in	7 in 10in -8in	4 12in 45-cal.	8 8in 45-cal. 12 7in 50-cal
									"Georgia" "Nebraska" "New Jersey" "Rhode Island" "Virginia"	1904	15,000	19	1700	11 in	6 in. 12in -8in	4 12in 40-cal	8 8in 45-cal. 12 6in 50-cal.
18 6 in 40-cal	4 9 4 in 40-cal	5½ in 10 in	9 in	1400 & 200 oil	18	11 840	1900 to 1901	"Wittelsbach" "Mecklenburg" "Schwaben" "Wettin" "Zahringen" "Kaiser Barbarossa"	"Maine" "Missouri" "Ohio"	1901	12,500	18	2000	12 in	7 in Krupp 12 in Harvey-Nickel	4 12in. 40-cal	16 6 in. 50-cal
14 6 in 40-cal	4 9 4 in 40-cal	none 10 in	12 in	1050 & 100 oil	18	10 700	1896 to 1900	K Friedrich III K Karl d Grosse K Wilhelm d Grosse K Wilhelm II	"Alabama" "Illinois" "Wisconsin"	1898	11,550	16	1450	16½ in. to 14 in.	6½ in to 14 in Harvey-Nickel	4 13 in. 35-cal	14 6 in. 40-cal
									"Kearsarge" "Kentucky"	1898	11,500	16	1210	16½ in. 14 in. to 11 in.	5½ in 17in.-12in. Harvey-Nickel 6 in 14 in. Harvey	4 13 in. 30-cal 4 12 in. 35-cal.	4 8 in. 40-cal. 14 8 in. 40-cal. 8 8 in 35-cal
	4 11 in 40-cal 2 11 in 35-cal	none 5 in Compound	13 in	1050	15	10 080	1891 to 1892	"Brandenburg" "Worth"	"Indiana" "Massachusetts" "Oregon"	1893	10,300	15	1800	18 in. to 15 in.	5 in 15 in Harvey	4 13 in. 35-cal.	8 8 in 35-cal. 4 6-in 50-cal.
						13047	Av.	26 Ships	29 Ships	Av	14,057						

noughts an immense advantage; and even the relatively small "Michiguns" can oppose the German 11-inch guns with an equal number of 12's. Now at 8,000 yards the 11-inch gun can pierce only 8½ inches of Krupp steel on direct impact, and all the vulnerable parts of the United States ships are covered with from 12 to 8 inches of Krupp armor, and their turrets and barbettes are protected by slanting plates 12 inches thick. Our 12-inch 45-caliber rifle, on the other hand, can send a shell through 11-inch Krupp steel at 8,000 yards, and not one of these four German dreadnoughts mounts a plate more than 9¾ inches in thickness, except on the barbettes. Is it not plain, then, that the four Yankee vessels, with their thirty-six 12's in broadside, are more than a match for the four "Westfalens" and their thirty-two 11's?

The discrepancy between the ten "Hannovers" and the sixteen contemporary battleships of the American navy is even more startling. The German main belts vary from 9 to

(continued on page 80)

Henry Fairfield Osborn

America's Foremost Palæontologist

By Benjamin C. Gruenberg

TO pursue science because it satisfies the human spirit, without any delusion as to the possible application of his results to the relief of pain or poverty, that is to be a "pure" scientist. Such a scientist is Henry Fairfield Osborn, one of the foremost palæontologists of America. When in 1906 he was tendered the great honor of election as secretary of the Smithsonian Institution, he gave as one reason for declining the post the fact that palæntology was of no immediate use to society and he would, therefore, not feel justified in asking for appropriations to enable him to carry on his costly researches at the probable expense of work more likely to yield results of practical value to the rest of us But he gave as another reason the fact that the material, equipment and assistants necessary for carrying on his researches were located in New York—and with his work he would stay

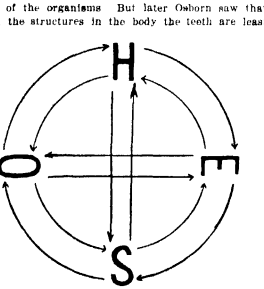
Prof. Osborn was born at Fairfield, Conn., August 8th, 1857, a descendant of merchants on both sides of the family He received his collegiate education at Princeton, and commenced his career as organizer and manager of scientific research even before he was graduated by organizing and leading the palæontological section of the Princeton scientific expedition to Colorado and Wyoming in 1877 He studied geology under Arnold Guyot, anatomy under Wm H Welch, comparative anatomy under Huxley, and embryology under Balfour While in England he was very much awed and inspired by a casual meeting with Charles Darwin when the latter was visiting Huxley's laboratory He taught natural science at Princeton and studied in Europe until 1881, when he was appointed the first Da Costa professor of biology (after 1895, of zoology) at Columbia University. Here he organized the biology department and established the Columbia University Biological Series, of which he edited the first ten volumes

In 1891 he was also appointed curator of vertebrate palæntology at the American Museum of Natural History During the twenty years of his active administration he brought together a collection of vertebrate fossils that is remarkable not only for being the largest in the world, and for being prepared in the most skillful and instructive manner, but also for the richness of some of its series—that of the horse, for example, being practically complete from early Tertiary times down to living forms of to-day In 1910 he retired from active teaching and administration to devote himself to research

Prof Osborn's contributions to knowledge are chiefly his collection of vast numbers of facts about the structure and distribution in space and time of vertebrate fossils, and his co-ordination of facts of paleontology in relation to the theory of evolution He always insists that palæntology is a branch of biology, not of geology, to which it is joined only through the fortunate accident that fossils are found in the rocks To mistake the position of fossils in the rocks, he says, "as indicative of their scientific affinities, is as logical as it would be to bracket Protozoa, which are principally aquatic organisms, under hydrology, or the Insecta, because of their aërial life, under meteorology" And he accordingly attempts to interpret the facts of palæntology in terms of organic evolution

Among his earlier studies was that on the history of mammalian teeth, which have given the comparative anatomist and evolutionist a great deal of comfort as well as trouble Teeth of primitive mammals, like the teeth of reptiles, have a crown consisting of a simple cone. The complex molars were believed by many odontologists and embryologists to have arisen by a process of "concrescence;" i e, the simple teeth were supposed to have grown together in groups as the jaw-bones gradually became shorter, and formed the compound teeth, just as separate petals were supposed to be "fused together" in such flowers as the cushion or the pumpkin. Osborn, on the basis of mammalian fossils, early came to the conclusion that the complex molars of this class of animals have resulted from the successive addition of cusps to an originally simple tooth which attained a tri-tuberculate form during the Mesozoic period. As a result of further studies he found that with the exception of a few aberrant forms all orders of mammals have shown the tri-tuberculate type of molar teeth, and that the original cone has always been represented by the front cusp on the inner edge in the upper molars, and by the front cusp on the outer edge in the lower molars. He also found that the successively appearing new cusp always followed a definite order. On the one hand, he developed from these studies an exact descriptive nomenclature of the mammalian teeth which replaced the conflicting and confusing terminologies of earlier writers from the time of Owen, and on the other hand, he developed the theory of "determinate variation" in the evolution of organisms

This idea, which he later renamed the doctrine of "rectigradation," he found to be practically identical with the "orthogenesis" of Eimer and other writers, and with the "mutations" of Waagen, and extended it to other structures The cusps of the molar teeth do not appear "fortuitously" and then survive in accordance with their relative fitness, as would be required by the Darwinian theory, nor do they appear fully formed in a discontinuous manner, in the sense of DeVries's theory, they appear at definite points, at first too small to have any adaptive or selective value, and become with succeeding ages larger and larger until they are of adaptive value In other words, they are *determinate* in their origins, they develop *gradually*, and they are *adaptive* in the direction of their development from the very start In his earlier studies Osborn considered these facts favorable to the kinetogenic theory advanced by Ryder and Cope, that is practically the neo-Lamarckian view of the evolution of structures being directed by the habits and needs of the organisms But later Osborn saw that of all the structures in the body the teeth are least



Osborn's modification of Weismann's germ-plasm diagram.

According to Osborn heredity, ontogeny, selection, and environment are inseparable in any discussion of evolution

able to show any such influence because they are fully formed before they emerge from the gums and they cannot improve with use, on the contrary, the more they are used, the more they are worn away, whatever virtues or fitness the teeth of an individual may show are congenital The rectigradations are thus not in themselves the result of selection nor of saltation, neither can they be accounted for on Lamarckian principles, they arise because of some inherent tendency or potentiality to vary in a determinate direction What this internal determining factor is we do not know It is not the same as Nägeli's "internal perfecting principle," since it operates in a direction parallel to ontogeny, that is, it causes evolution to proceed in adaptation to *new external conditions* For example, certain Eocene monkeys had become herbivorous, and their teeth developed so much like the ungulate type that their fossils were at first classed with ungulates

The same principle of hereditary ancestral control of variation was afterward found by Osborn to be illustrated by the origin of horns and other organs, and other workers found parallel facts in various series of fossils The date at which characters develop is determined by external factors, but the nature of the characters is determined by internal factors, at present "unknown" Thus a comparison of Eocene horses with contemporary titanotheres shows that the horse was developing the cusps more rapidly, but both groups were developing the cusp in the same predetermined order the law is illustrated also by the fact that similar characters have arisen simultaneously in groups of animals of common ancestry in Switzerland in Patagonia and in Wyoming On the other hand, certain characters seem to be less firmly bound up with hereditary control An example of this is the shape of the head, which Osborn found in a number of contemporary Mid Eocene branches of titanotheres, of undoubtedly common ancestry, to show a tendency to diverge into narrow and broad-skulled types In each diverging branch, however, once a tendency had established itself, the development proceeded to the limit without reversal

From a study of fossil horses in the course of which Osborn built up the history of this group in a very satisfactory manner, he passed to a thorough study of the titanotheres, which, of all extinct animals furnish the most complete series of fossils Here his earlier generalizations have been amply confirmed, and the "unknown factors of evolution" are still there to be discovered Instead of minimizing the difficulties unearthed by the palæntologists, Osborn thinks that scientific progress can be assured only if we frankly admit the limits of our knowledge in certain directions, he does not say we cannot know, but merely that here we do not know A good summary of his evolution creed was given by him in his address before the Palæntological Section of the International Zoological Congress in 1907

1. Many origins of new characters are due to some internal action in heredity

2 Many important adaptive characters arise determinately, definitely and by extremely slow stages

3 Degrees of similarity in such origins correspond to degrees of kinship

4 Degrees of kinship also affect to a certain extent, but not absolutely, the time of appearance, or the time of the origin, or the rate of evolution

5 The origins find expression not spontaneously, or irrespective of conditions, or from purely internal mechanical causes, but through some entirely unknown and at present inconceivable relation to ontogeny (habit and use) and to selection

6 If such origins do spring from internal hereditary principles, as they appear to do in many cases rapid origins (mutations of DeVries) may be simply due to the same law operating with a different velocity

In all his discussions of evolution Prof Osborn emphasizes the fact that the four recognized factors—heredity, ontogeny, environment and selection—are inseparable, and he criticises much of current debate because now one factor and now another is treated as if it acted uninfluenced by the others He would modify Weismann's well-known diagram showing the continuous line to represent the germ plasm by placing the four factors in a series wherein each is shown as influencing all the others, and being in turn influenced by them His philosophy attempts to harmonize the findings of the experimentalists, of the field naturalists, and of the palæntologists, the last, he says, have the best perspective, for they see the evolution of characters through long ages, without regard to particular organisms or species in which, for the time, they are perhaps being manifested

Prof Osborn's career is a splendid refutation of the prevailing clinical conception of "human nature," which can find no incentive to noble endeavor except in the pursuit of material gain guided by self-interest And it also vindicates the "pure" scientist against the charge of impracticality and inefficiency, for every institution with which he has been connected shows the work of a master in efficient organization and administration

Artificial Snails

SNAILS the only genuine part of which are the shells are now being sold in Paris, and it is said that the imitation of the real article is so close that many epicures have a high opinion of the sham product But it is to be presumed that they do not know that the snails are artificial, and they are certainly ignorant of the method by which the snails are manufactured

Snail-shells, it seems, are bought from the dustmen and rag-pickers, and after being cleaned are filled with "lights" or cats' meat, the soft flesh being cut into corkscrew form, so as to fit the shell, by a skillfully designed machine The receptacle is then sealed by means of liquid fat and the escargot is ready for the consumer The secret came out in consequence of an action brought by a man employed at the snail-factory to recover damages for a finger mutilated by one of the machines The artificial snails find a ready market.

The Latest of the Big Railway Terminals

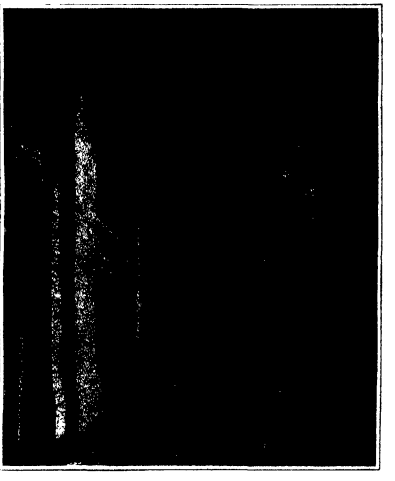
The Chicago Terminus of a Leading Western System

IN our special railroad number of June 17th last, we gave a description of the largest railroad terminal in the world which is now being built by the New York Central Railroad Company on the site of the old Grand Central station, and we drew attention to the fact that at the present time one of the most marked activities of the big railroads is the great scale upon which they are reconstructing their terminal stations in large cities to accommodate the ever increasing volume of traffic. The present article is devoted to one of the latest and most handsome terminal of this character which has been built by the Chicago & Northwestern Railroad Company as the eastern terminus of their line in Chicago. The station has been built to conform to the general work of track elevation which has been carried out in that city and forms one of its most important modern improvements.



The main shed, 840 feet in length, containing 16 tracks.

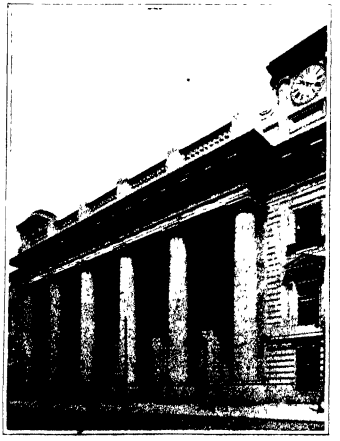
The main building of the station is a simple and dignified steel and granite structure four stories in height which has been treated in the early Italian Renaissance style of architecture. The main entrance, on Madison Street, is through a lofty Doric portico, which is carried upon a colonnade of six granite columns, each seven feet in its largest diameter and 61 feet in height. Back of this colonnade is a vaulted vestibule which is 132 feet wide, 22 feet deep and 40 feet high, entrance to the vestibule being by three imposing arches. At each end of the vestibule broad granite stairways lead up to the main waiting room, which is on the track level floor. There are similar vestibules of more simple architectural treatment at the Canal and Clinton Street entrances. These vestibules lead directly to a large public area, 200 feet by 92 feet, around which are ranged the ticket office, baggage room, and other essential accessories. At the center of this public space a grand stairway leads to the main course of the main waiting room on the track floor.



The inner vestibule.

The principal architectural feature of the station is the main waiting room, which is treated as a great Roman atrium, with a barrel-vault roof. The pilasters and the whole order, as high as the spring of the vault, are dull finished in light pink Tennessee marble. The columns are of Greek Cippolino marble, whose delicate green hue harmonizes agreeably with the bronze of the metal work which frames the glass between the pilasters. The vault is of ornamental tile construction, with richly ornamented ribs of terra cotta, whose color harmonizes agreeably with the marble of the walls. Excellent lighting effects are secured by two semi-elliptical windows 60 feet in diameter at each end of the vault, and ten circular lunettes, five on each side. The exterior walls of the station building are of gray Maine granite, and they are made continuous with the walls which inclose the train shed, the latter being of mottled gray brick, with granite trimmings. As the train shed walls rise to a height slightly greater than the roof of the train shed, they assist in giving to the entire station the external appearance of one huge building, and the total effect is enhanced by the dignified front façade, which rises to a height of 120 feet above Madison Street.

Of equal importance to the station building is the train shed, which extends to a total length of 840 feet, and covers in the 16 tracks and 8 platforms which serve the station. The place of the great steel-and-glass arched roof, which formed the invariable covering of large train sheds built from ten to twenty years ago, is taken by what is known as the "Bush roof," this being the first of its kind erected in Chicago. In this type the roof structure is carried on lines of columns, placed down the center of each platform, and the curve of the roof over each pair of tracks is broken by two longitudinal slots, through which the locomotive smoke-stack discharges directly in the open air. The roofs are of steel and concrete, and wired-glass skylights give ample light to every part of the train shed.



The main entrance, portico columns 60 feet in height.



Main waiting room, a dignified classic interior.

THE LATEST OF THE LARGE PASSENGER TERMINALS

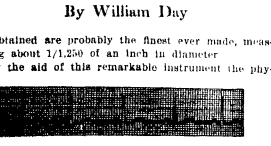
Heart Diagnosis by Electricity

By William Day

ONE of the most remarkable recent additions to the modern equipment for clinical diagnosis are the so-called "heart stations," now in operation at the Presbyterian and Mt. Sinai hospitals, in New York, and at the Johns Hopkins Hospital in Baltimore. The new apparatus represents the most refined diagnostic instrument at the service of the heart specialist, and not only enables him to follow with great certainty and clearness the specific features upon which his judgment of the case must be based, but it furthermore is capable of yielding data which would be quite unattainable either by the unaided human sense organs or with the aid of the ordinary instruments hitherto employed to extend somewhat the sensibilities of the organs of touch, sight and hearing.

The principle upon which the new method and apparatus are designed consists in the observation of certain electrical currents which accompany and are intimately related to the characteristic phases of the heart's action. The chief credit for the development of this method must be given to Waller, an Englishman, and especially to Einthoven, the noted Dutch physiologist. The latter it is who, in 1903, in his laboratory at Leyden, devised the so-called "string galvanometer," the most essential feature of the new apparatus. In most galvanometers the magnet is the movable part and the current to be measured passes through a stationary coil. In Einthoven's instrument this arrangement has been reversed; the magnet is stationary and the current passes through an extremely fine wire, measuring 0.001 to 0.003 millimeter in thickness. The filament may be of quartz covered with a fine silver coating to render it conducting, or it may consist of platinum. A very serviceable platinum thread would measure 35 millimeters in length, and from 2 to 4 micromes in diameter. This is about one-third to one-half the diameter of a red blood corpuscle. So delicate is the thread that it can be seen with the naked eye only when powerfully illuminated against a dark background. Such a thread is too light to be weighed upon even an extremely sensitive balance. Its weight has, however, been calculated by Einthoven to be about 3 to 7 thousandths of a milligramme. The ends of the thread are fixed, so that the thread is stretched and free to vibrate very much like the string of a musical instrument. This is the feature that has given the name "string galvanometer" to the device. The string is suspended midway between the pole pieces of a magnet, which is preferably an electromagnet. It operates on the principle that when an electric current is passed through a magnetic field, the conductor, if free to move, suffers a deflection perpendicular to the lines of force which pass between the poles of the magnet; thus when a current passes through the string of the Einthoven galvanometer this string is deflected to one side or the other, according to the direction in which the current passes. In order to obtain an accurate indication and record of the oscillations produced by the passage through the galvanometer of the feeble currents originating in the heart, a magnifying and photographically recording apparatus is provided. The cores and poles of the magnet are pierced through their centers, and two microscope tubes are inserted in the openings. One of these tubes is fitted with a lens for focusing a strong electric light upon the string; the other is a projection microscope which throws an enlarged image of the illuminated string upon the slit of the photographing apparatus, or else upon a white screen on which the movements of the thread can be observed directly by eye. Incidentally, it is interesting to note that a filament can be made from quartz fiber by a special process. The threads so obtained are probably the finest ever made, measuring about 1/1,250 of an inch in diameter.

By the aid of this remarkable instrument the physician can see and record the oscillations which the string undergoes as the result of the electric currents generated in the human heart during its muscular excitation which precedes every beat. The rapidity of the string movements, their extent, and the regularity or irregularity of their rhythm reveal significant information regarding the condition of the heart muscle. And the remarkable thing about the method is that the diagnosis may be performed with the patient in a distant room or building, the necessary connection being established through a line of electric wiring.

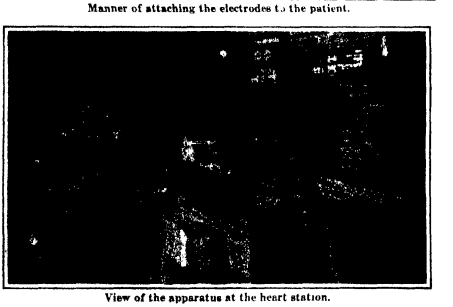


Portion of an electrocardiogram and an enlarged section of the same showing the characteristic features of each cardiac cycle.

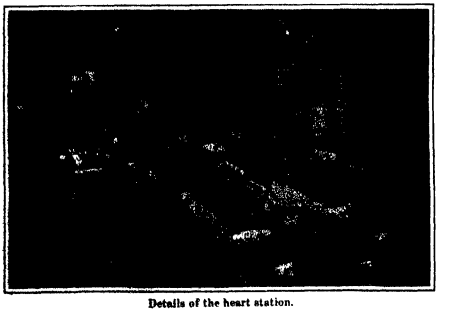
While the coarser features of the characteristic movement of the galvanometer string can be followed by eye for purposes of obtaining an exact record of all the finer features it is necessary to resort to photographic registration. The magnified image of the string is projected by means of a powerful electric light upon a slit in a dark box containing a moving photographic film. Ordinarily a film of half the length of an ordinary Kodak film is sufficient for one observation. Occasionally, however, much longer photographic films may be employed. A lever connected with a chronometer marking fifths or tenths of a second oscillates before one end of the slit so that a series of marks appears upon the film and clearly indicates the lapse of time corresponding to the several motions recorded upon the film. The record thus obtained is called "electrocardiogram."



Manner of attaching the electrodes to the patient.



View of the apparatus at the heart station.



Details of the heart station.

In the foreground are two arc lights. On the second table is placed the large galvanometer, for taking electrocardiograms, and the small galvanometer for registering heart sounds. On the wall is a telephone switchboard with connections to wards. On the third table is the multiple switchboard for making the various connections of the electrocardiograph.

One can, if desired, also record simultaneously on the same film a sphygmographic curve of the carotid pulse by placing before the slit a lever connected with a drum and receiver. But another expedient for this purpose is registration of the carotid pulse by means of a telephone and a second smaller galvanometer, the string of which is projected on the same slit. If desired, a third galvanometer may be used in connection with a microphone, and an electrophonographic record (or "cardiophonogram") of the heart sounds be made simultaneously with the electrocardiogram and carotid sphygmogram upon the film. This means that by the aid of the galvanometer and its auxiliaries the conditions of the heart and arteries can be investigated simultaneously in at least three different ways. (1) As regards the electrical changes in the heart muscle, (2) as regards the pressure changes in the carotid artery, and (3) as regards the sounds produced in the heart during activity or while it is at rest. Yet, as stated, the patient while the examination is being made, may be at a considerable distance from the heart station. Thus the electricity in the body of a patient in the hospital in Leyden, one and a half miles away, has revealed important facts regarding the condition of his heart to the physicians working in Einthoven's laboratory of physiology.

The apparatus in the heart station includes a whole series of different instruments, and is employed for the observation and recording of heart excitation and pulsation, heart sounds, pulse waves, blood-pressure etc., with a view of determining if the heart is healthy or diseased, and the station is remarkable for the delicacy and compactness of the apparatus which is accomplishing such results in the aid of medical science.

In operation the connection of the patient with the station is naturally of much importance, so that the current generated by the heart may be transmitted without loss if possible. The patient places left arm, left foot and right arm in three electrodes, which consist of zinc pans filled with normal salt solution of a strength of 8 grammes to the liter, or they may be made of German silver plates covered with felt and soaked in salt solution. From each of these, wires are conducted to three switches, by means of which any two of the electrodes can be connected to

(Continued on page 90.)

DIAGNOSING HEART DESEASES BY ELECTRICITY

Abstracts from Current Periodicals

Phases of Science as Other Editors See Them

Maintaining the Stability of Aeroplanes by Means of Gyroscopes

THERE are serious objections to the employment of gyroscopes for maintaining the stability of aeroplanes in the manner in which they are employed on the mono railway and in some experiments with nautical vessels In order to utilize the peculiar property of the gyroscope on an aeroplane it must be used as Capt Lucas Girardville has used it to operate special stabilizing devices in the manner of an auxiliary motor The principle of this application and the experiments made by Capt Lucas Girardville are described in a recent issue of *La Nature*, from which the following account is condensed

If a gyroscope, with its axis of rotation initially in the line *OZ* (Fig 1), its pivot at the point *O*, and entirely free to oscillate in all directions about this point, is acted on by a force which tends to turn the axis of rotation toward *OY* the axis will resist the effort and will move toward *OX* oscillating slightly to each side of the plane *ZOX* This oscillation is called nutation The value of the nutation is inversely proportional to the rapidity of rotation and is therefore negligible for great angular velocities

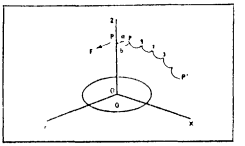


Fig. 1.—Principle of the gyroscope.

G gyroscope, OX, OY, OZ, axes of rectangular coordinates, PF, deviating force, Pp precession, ab, nutation

of the gyroscope The rotation of the gyroscope around *OZ* toward *OX* is performed at a nearly constant rate This movement, which is called precession is utilized for the operation of rudders by means of which the equilibrium of the aeroplane is maintained

The gyroscope is mounted in a carter which turns on two trunnions about an axis perpendicular to the axis of rotation The line of the trunnions is parallel to the direction in which stabilization is sought For example, if the line of the trunnions is parallel with the line of flight, any tendency of the aeroplane to pitch or tear will be counteracted by an elevating rudder operated by the reaction of the gyroscope The motion may be communicated to the rudder by a cord passing around a pulley attached to one of the trunnions (Fig 2)

The efficiency of this system has been shown by preliminary experiments in which the gyroscope and the rudder were mounted on an oscillating frame resembling the beam of a balance the carter turning on an axis parallel to that of the beam (Fig 3) The rudder was exposed to a uniform current of air produced by a blower and the apparatus was adjusted so that it remained in equilibrium In these conditions, if one end of the balance was depressed by the addition of a small weight or by touching it with the finger, the gyroscope, by means of a movement of precession about the axis of the carter acted upon the rudder in a manner so that the pressure of the current of air upon the rudder restored the equilibrium The apparatus was found to be so exceedingly sensitive that it was necessary to damp the oscillations by means of a plunger and a cylinder filled with water Experiments performed with aeroplane models showed that even with only 130 square feet of sustaining surface the reaction of the air upon the aeroplane made the hydraulic brake unnecessary, it was demonstrated that in free flight an aeroplane

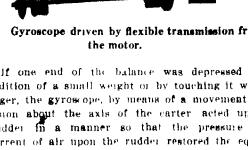


Fig. 2. Gyroscope driven by flexible transmission from the motor.

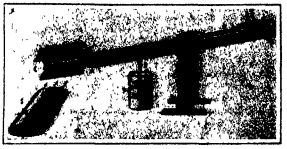


Fig. 3.—Experimental gyroscope balance.

AB, beam, C support, D, gyroscope, tt, trunnions, E, rudder, MN, shaft of rudder, S, blower, P, hydraulic brake

would not oscillate appreciably under the action of the gyroscopic governor

The gyroscopic governors always operated in the proper direction with sufficient energy to restore the equilibrium whether the equilibrium was disturbed by changing the distribution of the load, or by employing irregular currents of air

Capt Lucas-Girardville is now engaged in constructing and adjusting, at the Military Aviation Park at Vincennes, an aeroplane equipped with gyroscopic stabilizers In this apparatus a large bearing surface of nearly 1,100 square feet has been combined with remarkable strength by means of a special construction The main frame is a vertical pyramid of bamboo, which forms the central support of a great circle made of steel tubes, attached to the frame by means of three systems of radiating steel wires (Fig 4) This apparatus, which closely resembles an immense bicycle wheel 23 feet in diameter, is very strong and rigid At two opposite points of the circumference are attached two projections which resemble the wings

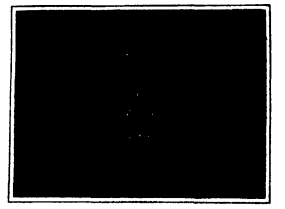


Fig. 4.—Circular frame of experimental aeroplane.

of an ordinary monoplane The large circle and the two wings, covered with canvas, constitute the upper plane of a biplane, of which the lower plane is formed of a much smaller rectangular surface, the width of which exceeds its length (Figs 5 and 6)

Two 70 horse-power Gnome motors of the new type are employed, placed in front of and behind the aeroplane in the line of motion These two motors, which are independent of each other, rotate in opposite directions in order to eliminate gyrostatic action in turning One motor drives a right-handed, the other a left-handed screw propeller. Hence the two motors, with their propellers, assist each other, and if one breaks down the other allows the fall of the machine to be retarded and made more gentle

The longitudinal stability of the apparatus is maintained by means of gyroscopes In the first experiments the gyroscopes were driven by the motor by means of flexible transmissions and friction rollers, but this arrangement has been replaced by an aerodynamic system, in which the energy consumed by the gyroscopes is furnished by a small auxiliary propeller exposed to the wind produced by the main propellers

The gyroscopes rotate at enormous speed, performing about 6,000 rotations per minute. As they are intended to assure longitudinal stability, they are so arranged that their movement of precession is performed about an axis parallel to the course of the aeroplane In these conditions, when the machine tends to pitch or rear, the axis of the gyroscope turns to right or left and operates a rudder which restores the equilibrium.

No attempt is made to supersede the human pilot in the control of the elevating rudders. The object is simply to correct temporary instability or a mistake made by the pilot.

By employing two gyroscopes both longitudinal and lateral stability can thus be assured to a certain extent. One gyroscope, with its axis of precession longitudinal, would control auxiliary elevating rudders, while the other, with its axis of precession horizontal and perpendicular to the line of flight, would move ailerons or warp the principal planes. In this application of the gyroscope to maintaining the stability of aeroplanes, it must be remembered that the gyroscope acts indirectly by operating moving parts, the effect of which can be increased, diminished, or annihilated at will by the pilot, by means of similar organs under his own control The gyroscopes do not exert any direct influence upon the aeroplane, because they are not rigidly attached to it

The problem, indeed, is very different from that of the mono railway, in which it is required merely to prevent the car from falling over sidewise, while the rail maintains longitudinal stability by presenting a line of support which prevents the vehicle from pitching or rearing A gyroscope, rigidly attached to the car, prevents the lateral overthrow of the vehicle by endeavoring to perform a movement of precession in a perpendicular direction, which is prevented by the presence of the rail In a freely flying aeroplane such an apparatus would cause the vehicle to capsize

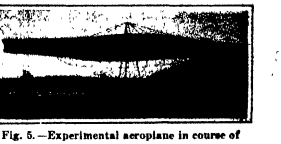


Fig. 5.—Experimental aeroplane in course of construction.

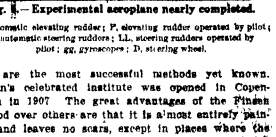


Fig. 6.—Experimental aeroplane nearly completed.

pp, automatic elevating rudder; F, elevating rudder operated by pilot; H, automatic steering rudders; LL, steering rudders operated by pilot; gg, gyroscopes; D, steering wheel.

Lupus and Its Treatment

AMONG the bacterial diseases of the skin, lupus is characterized by its extraordinary prevalence and the production of very deep lesions, which permanently disfigure so many faces In the scientific department of the Dresden International Hygiene Exposition the ravages of lupus are illustrated by a series of wax models which, according to *Hygieia*, show the social and economic importance of the diseases more convincingly than words could do According to the statistics of the German Health Bureau, 11,854 cases of lupus have been treated by German physicians since November, 1908 More than two-thirds of the patients were women

Lupus is treated in various ways Volkmann's method consists in scraping the affected parts with a sharp spoon, Thiersch employs excision and transplantation; while Hollaender recommends treatment with hot air and with Roentgen and radium rays The tuberculin treatment of Koch and Finsen's light cure are the most successful methods yet known. Finsen's celebrated institute was opened in Copenhagen in 1907 The great advantages of the Finsen method over others are that it is almost entirely painless and leaves no scars, except in places where the skin has already been destroyed. The apparatus employed by Finsen consists of a very powerful electric arc lamp of 30,000 to 40,000 candle-power, the rays of which are concentrated by quartz lenses The radiant heat is largely absorbed by a water cooling device As experiment has shown that the effective

ways are absorbed by the blood, and pressure is applied to keep blood from the surface. A hollow quartz lens, traversed by a continuous stream of cold water, is pressed firmly upon the diseased skin. The patient and the physician and attendants wear dark glasses to protect their eyes from the blinding light. Although the Finsen method is very successful, it suffers from the defect of requiring a long course of treatment which, in extensive development of the disease, may occupy many months, as only a fraction of a square inch can be treated each day.

A great advantage in this respect is possessed by Koch's tuberculin treatment, which rapidly dries up the pustules and checks the disease no matter how great its extent. The principle of the tuberculin treatment is the formation of protective bodies which kill the bacteria in the skin. The progress in the treatment of tuberculosis of the lungs has recently led to a new endeavor to combat lupus. Despite the progress that has been made, proper care for the unfortunate patients, whose disfigurement makes life a burden to them, demands the establishment of homes where they can find shelter and treatment. These homes could be partly supported by the work of the patients, according to their respective abilities.

The Great Waterfalls of the World in Their Relation to Industry and Conservation

THE waterfalls of the earth have become the subject of a conflict which is yearly increasing in violence. The lovers of nature wish to preserve the waterfalls in their original condition as far as possible for all time, while the engineers and industrial promoters seek to exploit them as sources of cheap power for electro-technical purposes. The accomplishment of this object on a large scale necessarily involves the total destruction or serious injury of the waterfalls, regarded as picturesque additions to the landscapes. It is only within recent years that waterfalls have been considered from the commercial point of view, but since it has been recognized that the energy of flowing water in very many cases furnishes a cheap and almost inexhaustible substitute for coal, which is yearly becoming more costly and more largely consumed, the great waterfalls which, as impediments to internal navigation, have hitherto been worse than worthless from the viewpoint of social economy, have suddenly become objects of very great value. The falling water drives the turbines of electrical power stations, producing electric light and power which, in many cases, is transmitted over hundreds and even thousands of miles. The war over the waterfalls which is now being waged by the friends of nature and the promoters of industry is likely soon to increase greatly in bitterness, for many celebrated falls have already been destroyed, or have at least suffered serious æsthetic injury, from the establishment of power stations. The famous Falls of the Rhine, at Schaffhausen, are at present the subject of heated controversy. Several power stations already stand on their banks and sap their life blood. The Swiss government, however, takes care to preserve a sufficiently large volume of water to maintain the character of the falls as a notable spectacle and an attraction for tourists. A still more bitter strife has been engendered in America by the question of the preservation or destruction of the Falls of Niagara. These famous falls have already narrowly escaped entire absorption in the pipes of power stations and very energetic action on the part of lawmakers, both in the United States and in Canada, has been required to keep intact from industrial invasion and preserve, in its original beauty, at least a remnant of this great wonder of the world.

Another North American waterfall which, as the highest fall in the whole world, especially deserves preservation as a natural monument, is apparently assured against destruction for all time. This is the Yosemite Fall in California, which makes a descent of 2,600 feet in three successive stages. As the whole Yosemite Valley, which was not discovered until 1851, was made a national park in 1864, the Falls of the Yosemite are under governmental protection and their pristine beauty can never be marred by the establishment of any power station.

There is a popular but erroneous impression, says Dr. Richard Herring in an article which is here reproduced from *Ueber Land und Meer*, that the Falls of Niagara are the greatest in the world, and even those more enlightened persons who know that the Victoria Falls of the Zambesi River in Africa are twice as broad and more than twice as high as those of Niagara, almost invariably assign to Niagara the second rank among the great waterfalls of the earth. Even this is an error, for South America possesses a waterfall which exceeds Niagara both in width and in height, and is actually the second largest waterfall in the world. This little known waterfall is that of the Iguassu River, a tributary of the Parana, and like Niagara it is situated at the boundary of two States, each of which owns half of it. The total water power of the Iguassu Fall, which is 213 feet high and nearly two miles wide, is estimated as about fourteen million horse-power. This is approximately equal to the aggregate water power of all Scandinavia, which is so rich in waterfalls, or about ten times the total water power of Germany. The temptation to exploit this great, inexhaustible, never-freezing stream as a source of power for industrial purposes may easily be imagined. At present such exploitation is quite impossible, as the Iguassu Fall is too far from the beaten tracks of commerce to make it profitable to establish any electrical power station, but it will probably not be long before these falls will be threatened with the fate of Niagara. This undesirable possibility has been foreseen by the interested States, Brazil and Argentina, which have already begun negotiations designed to protect the falls.

The largest of the earth's waterfalls, the Victoria Falls of the Zambesi River, in Rhodesia, which are 386 feet high and more than a mile wide, and which were discovered by Livingstone in 1855, have also become the subject of a compromise between the conflicting demands of the lovers of nature and the promoters of industry. The water power of these falls is estimated to be fully thirty-five million horse-power, two and one-half times that of the Iguassu, and five times that of Niagara. By way of comparison, it should be noted that the aggregate water power of the whole of Europe cannot greatly exceed thirty-five million horse-power. It is certainly possible to derive a few million horse-power from this great fall without appreciably detracting from its majestic beauty. The demands which are made at present are still more modest. The Victoria Falls Power Company ask for only 150,000 horse-power, less than 1/200 part of the whole, and the plans for the future development of the station involve no danger of the annihilation of the falls. The British government and the colonists know very well that the Victoria Falls, which since 1905 have been easily reached by the Cape-to-Cairo Railway, which crosses the Zambesi immediately in front of the principal fall, will certainly bring as much money into the country by attracting tourists as by producing electrical power.

There is no other waterfall in the world which is at all comparable in greatness with the Zambesi, Iguassu, or the Niagara. Asia, notwithstanding its colossal mountain ranges, is comparatively poor in large waterfalls which are found most abundantly in Africa and North America. The largest African streams, especially, are interrupted by many falls of considerable height. The Congo has several high falls which, owing to the great volume of the river (about sixteen times that of the Nile), may be counted among the most important sources of water power on earth. The Stanley Falls, in the middle reach of the river, consist of seven successive falls, of a total height of 164 feet and a width of nearly 4,000 feet, and offer an exceedingly rich source of power which probably will soon be exploited. Still more important is the total water power which the Congo develops in the non-navigable section extending from its mouth to Stanley Pool. Here the river, confined in a channel only a few hundred yards wide, and with a depth of water of nearly 300 feet flows with a velocity of 48 feet per second so that at every point of the stream 25,000 to 30,000 cubic meters, or about a million cubic feet, of water are hurled along with irresistible force, while thirty-two rapids and waterfalls lower the level of the stream by 829 feet in a stretch of 170 miles.

The lower Nile in Egypt possesses a series of rapids, the celebrated Cataracts of the Nile, but no waterfall in the strict sense of the word. True water falls occur on the upper Nile, the most beautiful of them at the point where the stream issues from Lake Victoria Nyanza. This Ripon fall is only a few yards in height, but the volume of water is so great that it presents a magnificent spectacle.

Comparatively few persons know which is the highest waterfall in Europe. The most voluminous of European waterfalls, strictly so called, are the Rhine Falls at Schaffhausen, but the highest are the Rjukan Falls of the Maan-Elf River, in the Norwegian province of Telemarken. The principal fall is 800 feet high and the total height of the two chief falls with the intervening rapids amounts to 1,837 feet, while the average flow of water is 50 cubic meters, or 1,760 cubic feet, per second. The largest water power station yet projected is here being developed by the Badische Anilin und Sodafabrik, in conjunction with other firms, for the fixation of atmospheric nitrogen. The Rjukan Falls, with their total energy of 250,000 horse-power, are already things of the past, for they have been irrevocably perverted to industrial uses. A similar fate threatens other small Norwegian falls, but Norway is so rich in waterfalls that it can well spare a few. In Sweden, likewise, the Falls of Trollhatta, the most celebrated of all Scandinavian waterfalls, have been almost entirely annihilated as objects of natural beauty. Nearly all of their water is now employed for the production of electricity. The government itself has recently established here a power station with a capacity of 40,000 horse-power. This, now the largest water power station in Europe, will soon be surpassed, however, by the station at Rjukan in Norway and by a still larger station in the north of Sweden, which will serve for the operation of the Lofoden Railway.

The Porjus Fall, at which this last-mentioned station will be placed, is only one fall, or rather rapid of a long series formed by the Lule Elf, near its source in the lake region of Lapland.

The largest and most beautiful of these falls is the celebrated Harsprang which forms the subject of many legends. The Porjus power station is expected to reach completion in 1914 and to develop soon afterward about 80,000 horse-power, yet the wild beauty of the Porjus Fall will be little affected as it is estimated that its total water power in summer after its sources of supply have been regulated, will be about 300,000 horse-power. In the Porjus Rapid the river descends 164 feet in about 2 miles. The Harsprang is also half waterfall and half rapid and accomplishes a descent of 244 feet in 1¼ miles. The Harsprang would therefore yield more power than the Porjus, but it is to remain untouched for the present, and it is to be hoped that it will be forever preserved as a natural monument. Sweden, with its great wealth in water power, can well afford such a luxury. Even little Finland is endeavoring to preserve natural beauty and has decided to keep her greatest waterfall in its original condition as a natural monument, and to allow no large power station to be erected on its banks. This fall is the celebrated Imatra Fall of the Wuoven River. The total descent is only 66 feet in two miles, but the volume is very great and the depth considerable while the width of the stream contracts from 570 to 150 feet in the course of the falls.

Some Engineering and Economic Results of the Commercial Motor Vehicle.

THE *Engineering News* recently expressed the opinion that "The commercial motor vehicle must be able to show an all-around saving in the cost of doing a given task before it can expect to find favor as compared with the horse-drawn vehicle."

Further, it states, the motor-vehicle must make a very substantial saving over the simple, cheap horse drawn vehicle in order to win success. Any motor-vehicle equipment is going to require a large investment compared with horses and wagons and the purchaser must be shown a good profit on this investment after the items of depreciation and repairs are provided for.

"The average merchant, or manufacturer or contractor is not going to make a large investment in motor trucks or motor delivery wagons unless these vehicles can earn a good deal more than six per cent net on their first cost. Most concerns are borrowing money at that rate to use in their business."

At the present time however experience accumulated from many sources appears to show that there are commercial motor vehicles now on the market which can, under favorable circumstances show a large saving over the cost of working with horse drawn vehicles.

The great advantage of the motor vehicle is that it can run at higher speed and carry heavier loads than any vehicle drawn by horses. Every engineer who has made an analytical study of the cost of wagon traffic knows that one of the largest items in the ton mile cost of freight haulage over common roads is the wages of the driver. It is an interesting fact that the lowest ton-mile costs for haulage by wagon over common roads in the United States are not made over the improved roads of the East. They are made in remote districts of the West, still beyond the reach of railways, where goods have to be hauled long distances over the crudest sort of highways and where the volume of traffic is such that teams of eight or a dozen or more mules are used to a load and one driver manages a load of several tons.

"It will be apparent from this that one of the most hopeful fields for the use of motor trucks is in any industry where the volume of traffic permits heavy loading and long hauls. The motor vehicle will make a better economic showing in heavy trucking, for example, than in light delivery wagon service. In the latter service again, the advantage will be much greater if run on a suburban and country route, where distances are long and stops are few, than on a city route, where a small area is covered."

HANDY MAN'S WORKSHOP

[The Editor of Handy Man's Workshop will be glad to receive any suggestions for this department and will pay for them, promptly, if available.]

A Simple Turnbuckle

By William Grotzinger.

A SIMPLE turnbuckle which I devised and used on my monoplane glider can be easily made as follows. Take the spokes and nuts out of an old bicycle



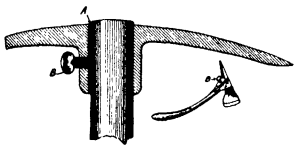
Turnbuckle made of a bicycle spoke.

wheel. Twist the wire at the unthreaded end, so as to form a loop to receive one end of the bracing wires. For the other end, cut a strip from a piece of sheet iron, 3 inches long and ⅝ inch wide, punch a hole in the center to receive the threaded end of the wire. Punch a small hole at each end of the strip to receive the other end of the bracing wires. Now bend the strip as shown in the illustration, and put the nut in place. You will then have a small, neat, strong turnbuckle, which can be used for many purposes.

Adz-tightener

By W. A. Lane

AT its best, an adz is a rather dangerous tool to use, and to have it work loose is nearly certain to end in disaster. A tightener as shown here is not expensive, can be put on any adz, and will last as long as the adz itself. On the upper edge of the head drill a hole and tap for a ⅜-inch set-screw as



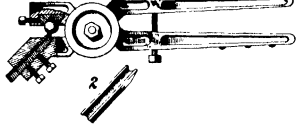
Adz-tightener.

shown in the drawing. Have the square head on the set-screw flattened like a thumb screw, so that you can tighten or loosen it with the claws of your hammer. Next, make a thin strip of iron the width and length of the upper side of the eye. The set-screw bears on this iron strip and makes the pressure on the handle even.

Turning Ball Joints to Gage

By C. G.

IN Handy Man's Workshop of April 1st, there was a description of a method of machining ball and socket joints. The writer is of the opinion that the tools used in the method described would be apt to



Device for turning balls to gage.

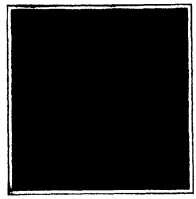
become dull in a comparatively short time, and then could not be sharpened without altering the gage. A friend of the writer recently designed the device shown in the accompanying sketch, which overcomes the difficulty. The cutting tool used is shown in perspective in Fig. 2. It will be observed that it consists of a bar with a channel in the upper surface which is of such shape that when the bar is cut off at an angle of 45 degrees, a cutting edge will be formed that will be a true semicircle. The tool is used in a device somewhat similar to a pair of pliers, as indicated in Fig. 1. In one of the jaws of the pliers is a bearing block with a pyramidal socket to receive the ball, while the cutting tool is mounted at an angle of 45 degrees in the other jaws of the pliers, with its cutting edge centrally disposed under the bearing block. With the shank of the ball end secured in the chuck of a lathe, the pliers are placed over the ball in the position indicated, and then the handles are pressed together until stopped by an adjusting screw, the tool in the meantime cutting the ball to standard gage. When the tool wears down, as will be the case after a few balls have been turned, it may readily be sharpened, provided the same angle is always preserved at the cutting edge.

An Improvised Bobbin Winder

By Henry H. Riggs

HAVING wasted much time winding small bobbins by hand for lack of a lathe, the last time I had to wind one it occurred to me to make use of a common drill brace, which proved so satisfactory as a bobbin winder that I pass the idea on to other amateur electricians whose outfit is limited as mine is.

The method is shown in the photograph. A drill shank or any bit of heavy wire will answer as a spindle to mount the spool on. If it does not fit the hole in the spool, wrap it with paper till it does, snugly.



Improvised bobbin winder.

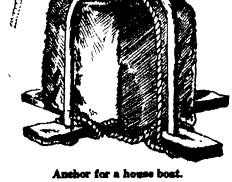
If a vise is not available, the brace can be clamped to the edge of the bench with a screw or two while the winding is being done.

A large spool of heavy wire can better be wound with a common carpenter's auger brace. The spindle on which the spool is slipped should be longer than the spool. The end is then supported by inserting it in a hole bored in the edge of the bench, while the butt end of the brace is supported in its traditional place in the "pit of the stomach." This leaves both hands free for winding.

Home-made Anchors

By Albert F. Bishop

HERE are two ideas that may be useful to the handy man who owns a boat, but doesn't own a suitable anchor. One of the illustrations shows an anchor of the conventional form, but made of wood and stone. A piece of wood with a natural bend is used for the fluke piece. The ends must be pointed and two holes must be bored through it, about 4½ inches apart, to receive two sticks of very hard wood. Each stick should have a knob on one end to keep it from drawing through the fluke piece. A stone should be placed between the sticks which may be sprung so as to em-



Anchor for a house boat.

brace the stone tightly. The sticks should then be well seized close to the stone and also at the upper ends. Anchor ropes are usually fastened to the fluke piece and thence pass up to the ring or loop, being seized there with a small cord. When pulling up the anchor this cord will break if the anchor is caught in the rocks. The rope will then capsize the anchor and probably release it. The writer saw this anchor on the bank of a river and thought it a very clever idea. The holding qualities looked very good.

The other anchor illustrated here is adapted particularly for houseboats. A cross of wood is made and holes are bored near the ends. A square weight is laid on the cross, and bows of hard wood are inserted in the holes and are drawn down tightly on the stone. The ends of the bows are well secured by means of hard-wood wedges. The rope is fastened to the cross



Wood and stone anchor for small craft.

and seized with a cord to the junction of the bows. This anchor was used by the captain of a small craft. He felt very secure when anchored with this home-made device.

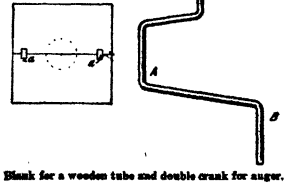
Making a Wooden Tube

By W. D. Graves

IN the days when iron pipe was more expensive than it now is, and wood cheaper, it was a common practice to bore logs lengthwise and to use them for carrying water underground, often for long distances. It was an easy matter to bore accurately in the center of logs because, in the kind of wood chosen for the purpose, a small open or pithy "heart" extended through it. This was very small, usually but little larger than a pin, but it was sufficient; for the worm of a bit found it to be "the line of least resistance" and would follow it. While this sort of wooden pipe is rarely to be desired, nowadays, it is sometimes desirable to have a wooden tube and to know how to make it. By making it in two parts one may arrange to guide the bit in much the same manner as did the old time aqueduct makers, and even more accurately.

These parts should be gotten out as shown in end view in the drawing, the two inserted tongues, *a*, *a*, serving to hold them relatively in place and to make the joint tight. Along what is intended for the center of the hole a deep gage mark is made, and, with a corner chisel or other tool, a small triangular section is removed for the whole length so that when the two parts are clamped together a small square hole will extend through where the center of the final hole is to be. The size this "pilot" hole should be depends upon the size of the bit or auger to be used. For a large auger it will not need to be more than an eighth of an inch square, and for a small bit the gage mark alone will often be found sufficient. It must be large enough so that the point of the worm will enter it, but small enough so that the bit will be firmly guided and drawn forward.

When boring the parts must be very firmly held together and the bit must be drawn out as often as the pod fills with shavings. For the latter reason it is advantageous to have a bit with as long a pod as



Blank for a wooden tube and double crank for auger.

is available. The shank of the bit is best lengthened by welding a steel rod to it. For turning it a common brace may be used; but if much work of this sort is to be done, it will be found to be accelerated by having the end of the rod bent into a double crank, like that commonly used on "ship augers," as illustrated. This is operated by taking hold at *A* and *B* with each hand. It requires a little practice to enable one to turn the cranks thus without making the bit wabble considerably; but as soon as one gets the knack he can do the work much faster than with a brace, and much more easily.

The Inventor's Department

Simple Patent Law; Patent Office News; Inventions New and Interesting

The Use of the Electro-magnetic Separator in City Refuse Disposal

THE magnetic separator is now largely used in various fields of industry, and is found to be of much efficiency in saving time and labor. It is employed to separate magnetic from non-magnetic material in a mixture of the two.

It is of value in handling coal, rock, and ore when it is essential that no large pieces of steel or iron should enter the crusher. It is also made use of for removing iron shot from molding sand, for separating brass chips from machine shop turnings, and for separating magnetic ores. This form of separator is also particularly useful in taking out the bits of iron or steel found in all sorts of junk, such as leather goods, rubber and rags, which must be removed before the material is worked over into new products, since if allowed to remain they would deleteriously affect the material or be a source of injury to the machinery.

Still another application is the use of the separator in grain elevators, cereal plants and flour mills. Before its installation much damage was caused to mill stones and other apparatus by the fragments of wire found in the grain as a result of the use of modern binders and reapers.

There are various more or less elaborate forms of separators, the simplest being the separator roller. The roller shown in the accompanying illustration consists of alternate coils and steel disks concentric with the shaft. The coils are wound on steel spools doweled to the disks, and the disks are in their turn keyed to the shaft.

Each coil is inclosed and protected by a cylindrical brass coil shield having a tight fit on each of the two adjacent poles. Current for the coils is obtained through carbon brushes held by self-adjusting holders on a pair of slip rings, at one end of the shaft.

These rollers are regularly built 12 inches in diameter, in lengths from 16 to 36 inches, and are driven by an electric motor mounted on the base of the machine. They have a current consumption of 325 to 750 watts, and capacities of 1,340 to 3,000 cubic feet per hour. They are designed to operate on any direct current voltage up to 250. They are usually installed as a part of a conveyer belt system.

The material falls from a hopper upon an endless moving belt below, and is carried along till it reaches the magnetized roller. The non-magnetic material being unattracted, is thrown off by centrifugal force to a bin or upon another conveyer belt, while the magnetic material attracted by the roller is held until it passes beyond the magnetic zone of the same on the under side, where it drops into another receptacle below.

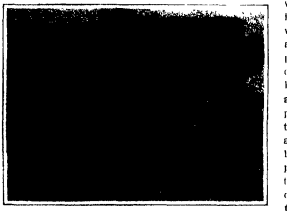
A novel and interesting application of this device is its use in garbage reduction plants. All city refuse contains a very considerable percentage of iron, chiefly in the form of metal cans, etc. It is very desirable to have this eliminated both because of its own value and to rid the other material of it.

The Borough of Richmond of the city of New York has recently installed a magnetic separator roller for this purpose, which has been running successfully for several weeks. It is believed to be the only one in the United States used for such a purpose, though several are in use in Great Britain. Mr. J. T. Featherstone, the superintendent of the Street Cleaning Department in Richmond Borough, gives some interesting data concerning the practical working of the separator.

The dimensions of the separator are 24 inches by 12, all the rollers being 12 inches in diameter. The cost of operation is very low, since one horse-power or less is sufficient to operate it, while the cost of the roller itself is not much over one hundred dollars.

About thirty tons of raw material daily are used. This is run through a furnace which melts it down into about twelve tons of clinkers, destroying at the same time the animal and vegetable matter. This, of course, is one of the main objects in city waste disposal, for sanitary reasons.

The clinker is then run through a crusher, and the resulting product passes onto a belt which carries it over the roller. On an average about 600 pounds of iron are recovered from the twelve tons of crushed clinker. The non-magnetic residue is used in the manufacture of concrete to take the place of broken stone and sand, and the process is especially valuable because the iron if allowed to remain would spoil the appearance of the concrete by a peculiar stain. It is probable that this process will be followed in other communities, when its simplicity and efficiency become known.



A new automobile tire pump.

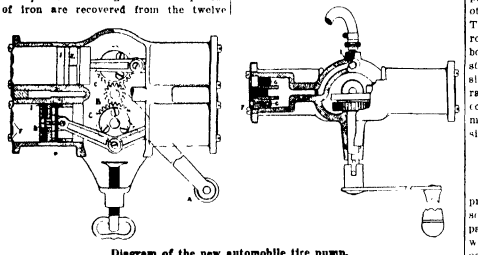
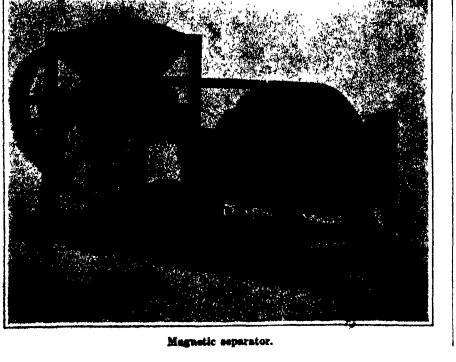


Diagram of the new automobile tire pump.



Magnetic separator.

A New Automobile Tire Pump

OUR illustration shows a new form of portable four-cylinder hand pump especially adapted for inflating automobile or motor-cycle tires. The aim which the inventor had in view in designing this pump was to provide a portable apparatus which could be readily attached to a suitable support such as the step of an automobile. The pump is furthermore so constructed as to combine great strength with simplicity of structure, so that it can be manufactured at a low cost, and is efficient and reliable in operation. The air passages are so formed as to avoid joints, which would be apt to become loose and to leak. With these objects in view the frame has been made in one single casting, consisting of a vertically disposed wall and cylinders integral therewith on opposite sides of the wall, the cylinders being disposed in axial alignment. Pistons reciprocate in these cylinders, being actuated by a handle *A* which is journaled centrally with respect to the cylinders in the central vertical plate. Suitable valves *D* admit air to the cylinders for compression and permit the escape of the air when properly compressed.

The passages for conveying the compressed air from the cylinders to the point of consumption are formed directly in the casting constituting the frame of the pump. Valves *G* are arranged in these passages for the purpose of preventing the return of the compressed air to the cylinders, and these valves as well as the intake valves *D* are so constructed that the use of ample lubricating oil in the cylinders will not result in the incomplete closure of the valves. The air inlet valves *D* are mounted upon each of the pistons and are automatically opened by suction by a friction operated piston ring *E*, during the return stroke of the piston. All four cylinders are arranged in opposite pairs with separate head plates. A powerful screw clamp is formed integral with the cylinder casting by which means the pump is readily attached to the running board. The pistons are operated by means of pinions *C C*, which have twice the number of teeth as the intermediate pinion *B* so that the clamp motion is geared down to the ratio of two to one.

Each of the driving gear wheels is screwed to a crank shaft and from the crank pins, connecting rods secured to pistons on opposite cylinders. The two crank pins are arranged at right angles to each other, so that when one pair of pistons is at the end of the stroke the other pair is approximately at mid stroke. The gears are cut gears. The connecting rods are made of manganese bronze. The bore of the cylinders is 1¾ inches and the stroke 2 inches, equivalent to an 8 inch single stroke, and as the pump is so arranged that the compression strokes come at equal intervals, the pump is remarkably easy to operate, especially since the crank handle is quite long.

Notes for Inventors

The Money in Little Things.—The profits resulting from patents of limited scope frequently come to the notice of patent attorneys in active practice. The writer recalls an instance in which the patentee of a harvester knife grinder submitted the patent for an opinion as to its scope. When told that the patent was limited very closely to the structure it presented and that almost a "Chinese copy" would have to be made to infringe it he said "That may be so, but I have made seven thousand dollars out of that patent in the last three months in the territory west of the Mississippi." Possibly his wits had been sharpened by the grinding operation, for we recall an itinerant scissors grinder of the Irish persuasion who opened the office door one day and called out "Has yez anything to sharpen up to day?" to which one of the office force replied "No! unless you can sharpen up our wits," and the answer came quickly back, "I have no stones small enough for that."

The One Millionth Patent.—Patent number one million will issue shortly, probably about the middle of August. The first patent of the present series was issued July 28th 1836 to John Ruggles (antedated July 13th, 1836) of Thomaston, Me., for a locomotive engine. One hundred and nine of the patents of the present issue were issued prior to January 1st, 1837, but these one hundred and nine patents were not regularly numbered on the patents themselves although the original drawings and the specification in the Patent Office are regularly numbered. On January 1st, 1837, however, the patents began to be regularly numbered with patent one hundred and ten issued on that day, and the numbering has con-

tinued until the present time. It will thus require only a little over seventy-five years to complete the issue of one million patents. Prior to July 28th, 1836, 9,957 patents had been granted. These patents have never been officially numbered but were numbered in their order by Examiner-in-Chief Skinner when he was in charge of the classification division of the Patent Office. It has been suggested that some ceremony be attached to the delivery of the one millionth patent but nothing definite along this line has as yet been decided.

A Woman's Patent.—Patent No 1,148,053 should be of interest to women because it is for a combined bread toaster and warming oven for use on gas stoves. Apart from any particular interest in the invention itself, the patent is notable because it was issued to a woman inventor, Minnie Agnes Phelps of Chicago, prosecuted by a woman attorney of Chicago and witnessed by two women.

Storing Patent Assignments.—The necessity of fireproof storage facilities for the assignment records of the United States Patent Office was called to attention in our issue of May 27th. The Fire Marshal P. W. Nicholson, of the District of Columbia has just submitted to the District Commissioners an extended report on the hazardous conditions existing practically throughout the Patent Office building. As to the general conditions in the Patent Office the Fire Marshal has this to say:

The worst conditions are on the third floor (9th Street wing). The entire floor and court do not taken up with combustible matter, wood shelving filled with official documents. The corridor is used by the public in the examination of records and the position of the official forces is obstructed by desks and tables.

There are two hallways extending from the floor to the ceiling filled with wood shelving in which are stored official documents with small niches hardly wide enough for one person to pass. The conditions are much congested. In the event of a fire the fire department would be much hampered by the obstructions from the corridors besides encountering a regular wall of fire. The stairways are hidden from view by the wood shelving and are not properly located. There are two who gates in this corridor, separating two different bureaus that are kept locked at night. This should not be allowed.

Concerning the storage of gasoline in a manner prohibited by the District regulations, the report says:

There is a small room in the basement 7th Street wing which is used for the storage of oils. I found in this room two cans each holding containing kerosene and one contain ing gasoline. The manner in which gasoline is stored should be abolished at once, as it is very dangerous. It is also liable to occur at any time, and if some person, not knowing the volatile conditions should strike a match a fire and probably an explosion would be the result. The regulations prohibit the storage of gasoline in this manner.

New Westinghouse Brakes.—A brake mechanism has been patented which has two winding drums. One of the drums takes up the slack in the chain and applies the brake shoes to the wheels, while the other drum applies the brake shoes to the wheels with the maximum braking power. Means are provided which are operated at a predetermined degree of braking pressure to cut the first drum out of action. The patent, No. 994,286, was issued to the Westinghouse Air Brake Company as assignor of Richard C. Swartzwelder of Edgewood, Pa. In a patent No. 994,220 Walter V. Turner of Edgewood, Pa. assignor to the Westinghouse Air Brake Company provides an air brake in which a number of brake valves act in connection with a single equalizing discharge valve device for the train pipe which is adapted to be operated by either brake valve, the brake va ves having ports and connections so they can control the pressure in the equalizing chamber.

Caffeinless Coffee.—Three reissues, Nos. 13,261, 13,262 and 13,263 have been granted of original patent No. 897,846, for the preparation or treatment of coffee in which the unbroken green coffee beans originally containing caffein, but freed therefrom, have their remaining natural constituents substantially unimpaired. In removing the caffein, the green coffee beans are treated with dry steam to loosen the molecular structure, then treated with gaseous chemicals to liberate the caffein from its salts, after which the caffein is extracted by a volatile solvent and the beans are subjected to currents of dry steam at different pressures.

The Cuspidors in the Patent Office.—Those who have visited the Patent Office will remember the large cuspidors that adorn the halls at intervals. It is told of a prominent Philadelphia lawyer of the old time that on one occasion he was sitting on the steps of the Patent Office nursing a lame foot. A Washington attorney asked what was the matter. He replied that he had been in and had a very unsatisfactory interview with a Patent Office examiner and it had been his habit when discussing patent matters before Congressional committees, if the results were unsatisfactory, to kick the rubber cuspidors then in use of the U. S. Capitol along the halls. On leaving the examiner's room after the unsatisfactory interview, he pursued the same tactics, thinking that the cuspidors in the Patent Office halls were also rubber, but he said with an exclamation "I found them to be cast iron and almost broke my foot."

The Need of an Easily Set Rat Trap.—Wasn't it Jay Gould who laid the foundation of a great fortune by the sale of rat traps? If so, and you have ever tried to set one of these five or ten cent affairs they sell in the department stores, you may well wonder why some one does not follow his example with a mouse trap that can be set without losing all one's religion.

Ross Turner as a Patent Office Draftsman.—A celebrity who was at one time an *attache* of the Patent Office is Mr. Ross Turner, the prominent water color artist. Prior to his European studies, Mr. Turner was a draftsman in the draftsmen's division. This, of course was many years ago but Mr. Turner is well remembered by some of the older officials.

Legal Notes

Color and Trade-marks.—In *ex parte* Austin, Nichols & Co., the Commissioner of Patents has held, affirming the decision of the trade-mark examiner, that where the applicant states that the color of the trade-mark is not claimed, the special lining of the drawing to indicate color should be omitted. Also that coffee and cocoa are goods of the same descriptive properties.

An Unfair Competition Decision.—The Supreme Court of the United States by Mr. Justice Holmes has delivered an opinion in the unfair competition case of Jacobs vs. Beecham, affirming the decision below and holding that the burden rests upon the defendant when sued for an unfair use of the plaintiff's name to justify his use of the name, also that the use of the name of a manufacturer of pills under a secret formula upon pills made by a competitor is not saved from being unfair because the name of the manufacturer is accompanied by a statement that the competitor makes the pills, even if it be conceded that he is using the others formula. The decision also refers to the use of the word "patent" as applied to proprietary medicines and holds that the use of the word "patent" to indicate a medicine made by a secret formula when the medicine is in fact not patented is not such a fraud as defeats the right of the manufacturer to relief in equity against unfair competition. In the decision it is said "The use of the word 'patent' to indicate medicines made by secret formulas is wide spread and well known. It is mentioned in the dictionaries and it occurs in the plaintiff's circulars."

RECENTLY PATENTED INVENTIONS.

These columns are open to all patentees. The notices are inserted by special arrangement with the inventors. Terms on application to the Advertising Department of the SCIENTIFIC AMERICAN.

Pertaining to Apparel.

HAT.—D. STARR, New York, N. Y. This invention relates to hats, and it has for its object the provision of one having a separate crown member, which may be readily mounted on a brim member, so that hats of many different styles may be quickly provided by the selection of the desired crown member, to be used with the brim member which has been previously selected.

Electrical Devices.

SIGNALING DEVICE FOR TELEPHONE SYSTEMS.—A. J. DE STROP, Kirkhan, Alaska. The main object here is to provide a signaling system in which the signals may be sent to a considerable distance, as far as the line is likely to be used for talking purposes. A further object is to provide a system with simple apparatus, including a relay for producing audible signals.

Of Interest to Farmers.

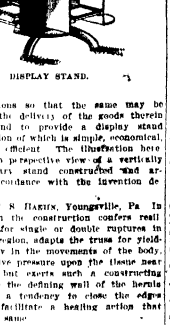
SAFETY CHECK FOR CUTTER BARS OF MOWING MACHINES.—N. ROGERS, Wolfboro, N. H. The object of this inventor is to provide novel means for automatically and instantly stopping the action of the cutter bar while the mowing machine is being moved, at the time the driver vacates the seat, on the machine when said vacation is effected purposely or accidentally.

Of General Interest.

MARKING STAKE.—M. F. ROGERS, Cement, Wash. The intention of this invention is to provide a stake having a weight near its pointed end for steadying the stake, and so arranged that it cannot slip on the stake, even should it become loosened. A further object is to provide an improved holding means for the stake when not in use, with which the stakes may be easily connected and disconnected.

PACKER FOR WELLS.—A. C. GRAHAM, Oil fields, Cal. One object here is to provide a packer which may be inserted within the casing directly in position and which is left in place in the casing after the insertion of the cementing material. The cementing material will firmly lock the packer in place, and the lowering device may be disconnected from the packer without disarranging it in its position at the end of the casing.

DISPLAY STAND.—WALTER GILBERT, St. Louis, Mo. Among the principal objects which the present invention has in view are: To provide a revolving stand arranged and constructed to facilitate the handling and display of merchandise packed in cartons, to provide a simple and efficient means for delivering the cartons so that the same may be handled for the delivery of the goods therein contained, and to provide a display stand the construction of which is simple, economical, durable, and efficient. The illustration here with, shows a perspective view of a vertically disposed rotary stand constructed and arranged in accordance with the invention described.



DISPLAY STAND.

TRUSS.—P. S. HARDIN, Youngsville, Pa. In this invention the construction confers resilient support for single or double ruptures in the inguinal region, adapts the truss for yielding conformity in the movements of the body, avoids excessive pressure upon the tissue near the rupture, but exerts such a constructive pressure upon the defining wall of the hernia as will have a tendency to close the edges thereof and facilitate a healing action that will cure the same.

LOADING WIRE FOR TRAVELER DISPENSERS.—J. S. DRAKE, Lancaster, S. C. The object here is to provide means for supplying travelers to the dispensing device, by means

LEGAL NOTICES

PATENTS

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PATENTS FOR SALE

FOR SALE.—Outright, U. S. patent 949,230, combination of series padlock and locking device for any article sold. Simple, attractive, durable. Small capital required. Unquestionable sale. John Junkunc, P. O. box 583, Pocatello, Ida.

FOR SALE.—I have invented a lead rule for cattle. Patent No. 1,184,. I desire to sell this patent for full particulars about this invention and other information, address, F. P. Williams, Jr., Bend, Oregon.

FOR SALE.—Patent No. 991,30. This is a joint fastener "Invisible" for window, screen, storm doors, etc. No nails or screws used. D. A. Wright, 316 4th St., San Antonio, Texas.

THE PATENTEE of No. 987,78, a metal device for holding paper targets, especially useful for indoor practice rifles, wishes to have same manufactured, or will sell patent or invest it in a factory. C. F. Worrell, Zanesville, Ohio.

WANTED.

LOCAL REPRESENTATIVE WANTED. Splendid income assured right man to act as our representative also learn how our business is conducted. Small amount experience unnecessary. All we require is honesty, ability, ambition and willingness to learn a lucrative business. No soliciting or traveling. This is an exceptional opportunity for a man in his locality to get into a big paying business without capital and become independent for life. Write at once. Universal Company, Address, E. R. Marden, Pres. The National Co-Operative Real Estate Company, L. 336, Marden Building, Washington, D. C.

MISCELLANEOUS.

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LISTS OF MANUFACTURERS.

COMPLETE LISTS of manufacturers in all lines supplied at short notice at moderate rates. Small and special lists compiled to order at various prices. Estimates should be obtained in advance. Address Munn & Co., Inc., List Department, Box 773, New York.

INQUIRY COLUMN

READ THIS COLUMN CAREFULLY.—You will find inquiries for certain classes of articles numbered in consecutive order. If you manufacture these goods write us at once and we will send you the name and address of the party desiring the information. There is no charge for this service. In every case it is necessary to give the number of the inquiry. Where manufacturers do not respond promptly the inquiry may be repeated.

MUNN & CO., Inc.

Inquiry No. 9236. Wanted addresses of parties having Phonographs repaired, if able to help one.

Inquiry No. 9237. Wanted addresses of firms selling second-hand theater furniture.

Inquiry No. 9238. Wanted addresses of parties having new machinery for sale in any part of the world.

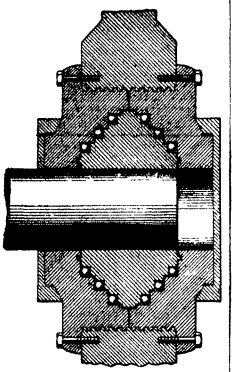
Inquiry No. 9239. Wanted name of party who is reported to be manufacturing a machine for [illegible] the position of a [illegible].

Inquiry No. 9240. Wanted addresses of parties able to sell [illegible] machinery.

Inquiry No. 9241. Wanted addresses of manufacturers of [illegible] cement, cement or other materials suitable to use therefor.

which the travelers will be held in proper position for dispensing, and supplied to the device in such position. With the improved binding wire, the travelers may be placed on the magazine in proper position for dispensing, and they cannot become disarranged during transfer, neither can they be lost from the wire, if the pins are retained in place, until the binding wire is centered.

ROLLER BEARING.—LUTHER BADGER, St. Johns, Ore. This roller bearing is designed for general purposes, as, for example, car, locomotive, automobile and other vehicle wheels, and also machines of various characters. The invention is shown in the engraving which represents a central longitudinal section of the bearing and the improvement contemplates an anti-friction bearing capable



ROLLER BEARING

of free working under end thrust in either direction or a lateral strain as that occasioned by the weight of the load the bearing consisting of an inner and outer bearing member, and an internally threaded bearing support, the inner bearing member increasing in diameter in passing from the ends toward the center and the outer bearing member composed of two sections threaded into the bearing support from the opposite sides thereof.

Hardware and Tools.

WRENCH.—CHARLES KANE, National Military Home, Tenn. This wrench is provided with different sized jaws, any one of which can be readily moved into active position and securely locked thereto. Use is made of a jaw head mounted to turn on the end of the wrench handle and having a plurality of integral jaws of different sizes and a bolt slidable lengthwise on the handle and

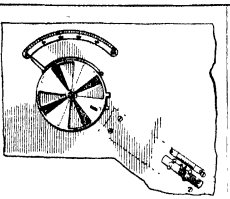


WRENCH

having its outer end reduced in step form to engage and fit any one of the jaws, to hold the jaw head against turning in either direction on the handle. The engraving shows a plan view of the wrench having two jaw heads. It is all steel and durable, the jaws and locking bars are tempered cold steel and contain neither rivets nor threaded screws in the locking parts. The revolving jaws respond readily to the movement of the push button, and the angle at which the head locks, enables an operator to reach nuts or bolt heads in narrow and intricate spaces.

Heating and Lighting.

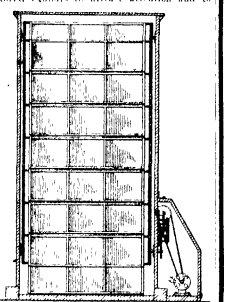
OVEN THERMOMETER AND VENTILATOR.—HENRY C. FRANKENBERG, Bonners Ferry, Idaho. This device will automatically regulate the draft of an oven, whereby to maintain a predetermined temperature, will indicate the temperature and may be regulated to operate at different temperatures. The engraving shows a front view of a portion of the oven, with the improvement in place. Superposed strips and damper are so arranged that between certain predetermined temperatures, the damper is not affected. When, however, heat exceeds predetermined high temperature, the damper is closed, the composite bar being flexed toward the lamina having the lowest coefficient of expansion. As soon as the damper is closed, temperature rises, and the damper again gradually opens and is held open until the high temperature falls. When the damper is open or closed, some little variation in temperature is permitted before the damper operating mechanism again comes into play.



OVEN THERMOMETER AND VENTILATOR

Machines and Mechanical Devices.

PICTURE DISPLAY CABINET.—MARK C. PHILLIPS, State Agricultural College, Corvallis, Ore. Among the principal objects which this invention has in view are: To provide an automatic mechanism to expose successively pictorial exhibits to attract attention and to

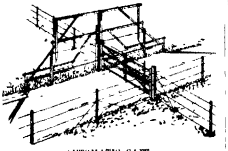


PICTURE DISPLAY CABINET

please passers by, and to provide a flashlight mechanism for periodically illuminating the said exhibits. The illustration shows a vertical longitudinal section of a machine which in operation gives an attractive and continuously uninterrupted display of pictorial designs interspersed with entertaining advertising matter.

RAZOR STROPPING MACHINE.—A. TOMANDER, New York, N. Y. This machine may be operated alternately by motor or manual power. The blade is addressed in approved position to the stropping members, the blade is oscillated to present opposite sides thereof to the stropping members, the stropping device has a continuously moving double belt adapted to receive therebetween the blade to be stropped, the double and face buffed stropping member is arranged to receive between the faces thereof the blade to be stropped, the device holds the blade in inclined position when stropped, and means provide for varying the belt tension.

AUTOMATIC GATE.—LOUIS A. LAAS, Maxwell, Texas. This invention relates to automatic gates and more particularly to gates that are unlatched and opened by a vehicle approaching along the road and closed and latched again through the same agency, all of which is done automatically. An object is to avoid entanglement between the swinging gate



AUTOMATIC GATE

itself with many or heavy operating parts. The gates is shown in the accompanying engraving, which pictures the various features of the construction, among which is the provision at each side of the swinging gate of separate vehicle-engaged road members, preferably in the nature of fulcrumed running boards, and located at opposite sides of the road, one of which controls the opening and the other the closing of the gate.

NOTE.—Copies of any of these patents will be furnished by the SCIENTIFIC AMERICAN for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

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TO have a Warner Auto-Meter on your car is more important to you than the top, the glass front, or any other accessory. It's almost as important as *the car itself*. This statement may at first seem overdrawn—but

Consider These Points—

No matter what top or glass front you select, you cannot go far wrong—all are good. *There is no definite standard of value.* The *Warner* is recognized as the Standard of Speed Indicator Values because of its Supreme Quality and enduring accuracy. You can go *away wrong* if you select the wrong Speed Indicator, for not all are good.

* * *

The Speed Indicator is the most-looked-at thing on an automobile. The driver refers to it constantly every instant the car is in motion.

Other car owners and those who pass your car when drawn up at the curb, *look for the Speed Indicator* when deciding for themselves or for others whether you are driving a good car or not.

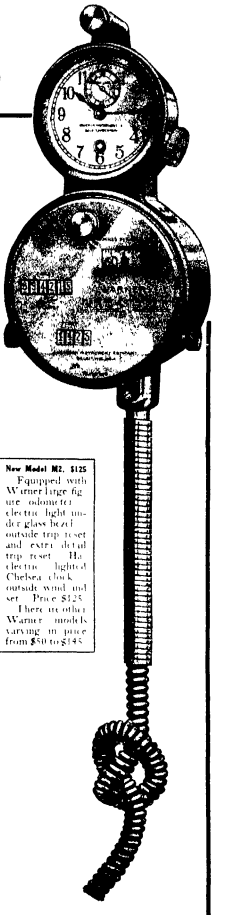
It is common knowledge among Motorists and Laymen that the Warner is the *Highest-Quality* Speed Indicator and that it is used on the *best cars*.

Therefore, if the car carries a Warner on the dash, they unhesitatingly brand that car as *Good*. If it is an inferior and unreliable Speed Indicator, the Quality of the car is open to suspicion in their minds. Our Branch Managers and Salesmen in every important city report having many times heard people on the sidewalk, who have stopped beside a car, say in almost the same words:

"I do not see the name of the car, but it *must be a good one* for it has a Warner Auto-Meter on it."

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Warner Instrument Company

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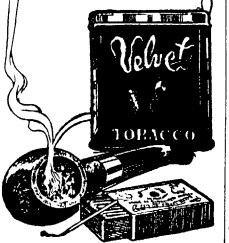
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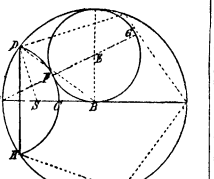
Notes and Queries

Kindly keep your queries on separate sheets of paper when corresponding about such matters as patents, subscriptions, books, etc. This will greatly facilitate answering your questions, as in many cases they have to be referred to experts. The full name and address should be given on every sheet. No attention will be paid to unsigned queries. Full blasts to correspondents are printed from time to time and will be mailed on request.

(12493) A E S asks: 1. Can you inform your subscribers the degree of coefficient of expansion and the malleability of copper, brass, aluminium, soft iron, and steel? A. The coefficients of linear expansion for the metals you name are per degree Fahrenheit, and at a temperature of 104 deg Fahrenheit, as follows: Copper, 0.00000810; brass, cast, 0.00001041; brass wire, 0.00001072; aluminium, 0.00001285; soft iron, 0.00000672; annealed steel, 0.00000907. No figures regarding malleability are reliable unless the condition of the sample is carefully determined. The general order of the pure metals in malleability, as known, is: Easiest is gold, silver, aluminium, copper, tin, lead, zinc, platinum, iron. 2. What is the metal or alloy having the nearest coefficient to glass? A. Platinum is the only metal which has the same coefficient of expansion as glass.

(12494) A. W. K asks: Has anyone any experimental knowledge of a substance which, if shaped like a wedge, will weigh more when lying on its side than when lying on its back with the edge up? The writer firmly believes this to be possible, and that the heaviest substance is most likely to exhibit this phenomenon. A. We can answer your question that a wedge will weigh less when standing upon its head than when lying on its face, since in the former position its center of gravity is farther from the center of the earth than when it is on its face. It would require most delicate balances to show this in any piece of metal which such balances can weigh correctly.

(12495) F R S says: I was interested in a method given in query 12456 for inscribing a hexagon in a circle, and hereby submit a geometrical solution for same. It is only a combination of two problems in the ordinary text books. I thought the solution might be of interest to your readers.



A Theorem: Line HB, as side of inscribed pentagon. Proof: First, to prove that AC is a mean ratio between AB and BC or

$$AB : AC :: AC : CB$$

$$AB = AE - EB$$
$$AB^2 = (AE - EB)^2$$
$$= (AF + FE)^2 - EB^2$$
$$= (AF + EB)^2 - \overline{EB}^2$$
$$= \overline{AF}^2 + 2AF \times EB$$
$$= AF(AF + 2EB)$$
$$AC(AF + FC)$$
$$AC(AC + AB \text{ since}$$
$$BE = \frac{AB}{2} \text{ (construction)}$$
$$= \overline{AC}^2 + AC \times AB$$
$$AB^2 - AC \times AB = \overline{AC}^2$$
$$AB(AB - AC) = \overline{AC}^2$$
$$AB : AC :: AC : CB \text{ or}$$
$$\frac{AB}{AC} = \frac{AC}{CB} \therefore AB : AC :: AC : CB$$

Make $AS = CB$, $BB = AC$

Now, from above: $= AB, BS :: BS : AS$ by construction and $AD = AC$ by construction. AB AD : AD AS, hence $\triangle BAD$ and SDA are *similar*, but $\triangle BAD$ is isosceles, $\therefore SDA$ is isosceles and $AD : DS :: AC : SDB$ is isosceles and $\angle DBA = \angle ADS$, but $\angle DSA = \angle DBA + BDB = 2DBA$. Hence $\angle DSA = 2DBA$. Sum $\angle s$ of $\triangle DBE = 5 \times \angle ABD = 5$rt $\angle$s and $\angle ABD = \frac{1}{5}$ of 5rt $\angle$s or $\frac{1}{5}$ of 4rt $\angle$s. Hence AD = $\frac{1}{5}$ of a circumference *or arc DAH is $\frac{1}{5}$ of a circumference!* Q. E. D

(12496) G O B says: Your answer to query No. 12467 in your June 10th issue interested me greatly. I want to ask: 1. If the rise in temperature of air during compression is due to the more rapid collisions of the molecules? A. The compression of a gas is the effect of a mechanical force against the outward pressure due to the heat energy of the gas, which varies with its temperature. The result of the compression is to bring the molecules nearer together and produce more collisions per second by reducing the mean free path through which a molecule can move before it collides with another molecule. The outward pressure is increased, and the collisions are both more numerous and more violent. The temperature is raised for both reasons. 2. What is the cause of the drop in temperature upon the air being released from pressure? A. The opposite action, namely, expansion, produces the opposite effect, namely, a drop in temperature. The distances between molecules are increased, the mean free path is lengthened, and the number of collisions is reduced.

(12497) O W E asks: Would you kindly tell me where I could get some information regarding "colloidal solutions," or a finely divided metal in a liquid? I am particularly interested in copper. If you have any SUPPLEMENTS containing anything on this subject, kindly tell me what they are. A. You will find valuable articles upon colloidal solutions in the SUPPLEMENT Nos. 1477, 1581, 1779, 1804, price ten cents each. The subject is treated in all the physical chemistries. We can send you Jones's "Physical Chemistry" for $4, also Zsigmondy's "Colloids and the Ultramicroscope," price $3.

(12498) J. S. R. asks: 1. I would like to know if there is any substance of any kind that smoke will dissolve or act on in any way. A Smoke is a mixture, differing with the fuel which is burned, and with the incompleteness of the combustion. The black portion which we usually call the smoke is simply the unconsumed carbon drifting away. This cannot dissolve anything. The gases from the combustion are able to act upon many materials and corrode them. There is also much hot-water vapor in smoke, which becomes water when it is cooled and aids the rusting of iron or corrosion of other metals upon which it may be condensed. 2. Is mercury a conductor of electricity, or anything in liquid form that is? A. Mercury is a conductor of electricity, as also are all solutions of metallic salts such as copper sulphate and common table salt, and most acids mixed with water. There are thus a great many liquid conductors.

(12499) H O. S says: Regarding the sounds given forth by the reproducer of a talking machine, the manager of the record department of one of the principal companies asserts that during a band selection all the instruments playing at one instant are given forth by the producer at one instant or at the same time. Now will you kindly answer this: Is it not a fact that any object giving forth different tones by vibration can have but one rate of vibration with its accompanying tone at any one instant or fraction of a second it being impossible for it to vibrate at two different rates at the same instant? I have always understood and believed this to be so, and it seems to me to disprove the record department manager's assertion. Taking the length of the record groove passed over by the reproducer during one second my opinion is that there is but one sound at any one time, as there is one sound each smallest fraction of the second and they follow each other so swiftly, the ear cannot comprehend that it is being deceived, and believes it hears more than one instrument at the same time. Could not this be positively ascertained by having two trombones or cornets play each a different sustained note, and see if the reproducer would give the two tones together or two different notes on an organ would be more mechanically exact and even. A. It is not a fact that any object giving forth different tones by vibration can have but one rate of vibration with its accompanying tone at any one instant or fraction of a second. It is very possible for it to vibrate at two different rates at the same time. The difference in tone quality of different musical instruments is due to this very fact, and a vibrating string of piano or violin vibrates at a large number of rates at the same time. The recorder of a talking machine takes a form of motion due to the resultant of all the forms of motion which it receives from the sounding instruments, and for this reason the record can impress upon the reproducer the same tones as it has received from the motion of the recorder. Doppler's Principle is the accepted explanation of this fact. Many tracings of combined tones have been made. It is of course very difficult, if not impossible, to extend such records to the very complicated results of the impressed curve of the disk of a talking machine for an orchestra, but the fact that this is true of simpler compositions of tone leads with certainty to the belief that it is also true of the complex tones of the band or orchestra. We do not look for any change in the accepted theory on the matter. The opinion of the manager of the record department which you quote is entirely in accord with our own.

(12500) J. W. N. asks: Under the rules of science, as taught by the institutions of the world, is it possible for any man or agency to forecast the weather for months

Do you know how to judge a motor oil? My booklet "Motor Lubrication" will help you. It tells of the perfect lubricating qualities of

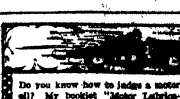
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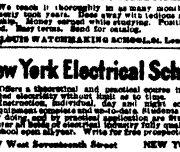
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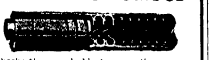
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ground, as is done by a few self-annointed prophets and so-called weather bureaus of this country? A. It is not possible to foretell the weather for any extended period, beyond the most general terms. The U. S. Weather Bureau after years than forty years of continuous practice does not attempt specific predictions for more than thirty-six hours. Long-range forecasting is not yet reliable. The conditions which determine the motions of the vast masses of the atmosphere are too little known. When a storm appears in our western region, it is not possible to tell at what point it will leave the Atlantic coast, or what its path will be across the country. The success of the U. S. Weather Bureau in forecasting storms, frosts, and river floods is very remarkable, and this work of the Bureau is worth many times its cost, but those men are very careful to disclaim the ability to predict the weather for any specified place for any extended period.

NEW BOOKS, ETC.

THE SHIPPING WORLD YEAR BOOK. A Desk Manual in Trade, Commerce, and Navigation. Edited by Evan Rowland Jones. London: The Shipping World Offices, 1911. 8vo.; 1765 pp.

The twenty-fifth edition of this well-known annual is bigger and better than ever before. Scarcely anything of importance within its scope has been omitted. The new tariffs of Austria-Hungary, Bulgaria, France, Japan, The Netherlands, Sweden, and Greece are given. There is a complete port and harbor directory of the British Isles and a directory of all the commercial ports of the world, with particulars as to accommodations, charges, tides, trades, pilotage and towage, revised up to the hour of printing. Among new features of the edition may be mentioned the tables of freeboard, a digest of the merchant shipping Acts from 1894 to 1909, tables of foreign money, weights and measures, with English equivalents, foreign trade statistics for 1910, details of the world's shipbuilding output for the past year, and a mass of invaluable information which the exhaustive index makes easily available. A new map of the world, especially prepared by J. G. Bartholomew, F. R. G. S., folds into a pocket at the back of the volume. This shows the routes of steamers and railways throughout the world, and the products, ports, coaling stations and coal fields of all countries.

ARGENTINA AND HER PEOPLE OF TO-DAY. By Nevin O. Winter. Boston L. C. Page & Co., 1911 8vo.; 421 pp.; Illustrated. Price, $3.

Argentina, like the other countries of South America, has received far less consideration than it is entitled to. One of the greatest food-producing countries of the globe, queen of the South American republics, first among them all in import and export trade, with a capital ranking as one of the greatest cities of the world, Argentina must quicken the pulse of all who are attracted by the new, the progressive, the resourceful, and the ambitious. We have in the volume before us, to use the author's own designation, "an account of the customs, characteristics, amusements, history and advancement of the Argentinians, and the development and resources of their country." It is a brightly-written and well-made volume enriched by charming views and illustrations.

NORTH DEVON WITH WEST SOMERSET. By Beatrice and Gordon Home. New York: Frederick Warne & Co. 12mo; 230 pp; illustrated.

This is a little volume to fit the pocket, containing some very good views of the countryside, coast scenery, and picturesque buildings. The part of England with which it deals has an exceptional and distinctive beauty, as everyone knows. Such names as Covelly, Ilfracombe, and Exmoor conjure up pictures of appealing quaintness, glimpses of rugged promontories and far-flung bays lying in purplish light, and stretches of wild moor and wild-blown spaces. We are now in the land of Lorna Doone and her "girt Jan Ridd." The book is not a stereotyped guide, although its large-scale maps slight nothing, but is almost like a gift-book in style and make-up—would, indeed, admirably serve that purpose—and is full of sympathetic description and discriminating illustration.

HOMESTEAD. The Households of a Mill Town. By Margaret F. Byington. New York: Charities Publication Committee, 1910. 8vo.; 262 pp. Price, $1.50; postage, 30 cents.

Homestead is a town. Homestead is also the mill which perpetuates the town. But Margaret Byington's book is mainly of the home life the mill town lends on the wages which the mill pays. It is a community of working men, representing an early Teutonic-Celtic wave of immigration and a later Slavic influx. Perhaps the main interest of the survey centers on "life at $1.65 a day." We are set so much drawn to a study of middle-class living and hundreds respectability. Our literature must give us either the prince or the pauper—either Brewster's millions or the widow's mite. These nine-dollars-a-week men with wives and families can allow themselves just twenty-two cents per man for a day's food. The Committee on Trade and Commerce estimated that in Pittsburgh a liberal provision of food for a family of five could not be purchased for less than $11 88 per week. From these contrasting figures we may draw our own conclusions as to the unenviable state of the unskilled worker in the steel mills. Rents are high. The twelve-hour day, continued in many cases through the seven days of the week, leaves no time for anything else save food, a pipeful of consolation, and sleep. This is of course the shadow of the picture, there are higher lights. The volume is one of the six which comprise the notable Pittsburgh Survey findings, and is remarkable for the way in which it goes to the very heart of things and tabulates human strivings, longings, and limitations in columns of cold type.

THE CHEMISTRY OF THE COAL TAR DYES. By Irving W. Fay, Ph.D. New York: D. Van Nostrand Company, 1911. 407 pp. Price, $4 net.

The book gives a good presentation in concise form of the principal classes of organic dyestuffs. An idea of its contents and their arrangement may be obtained from the chapter headings, which are as follows: 1 Introduction, 2, Coal Tar and Its Products, 3 and 4 The Hydrocarbons and their Derivatives 5 The Nitro and Nitroso Dyes 6 The Triphenylmethane Dyes 7 The Classification of the Coal-Tar Dyes 8 The Azo Dyes 9 The Seven Food Colors (Devoted to the seven dyes whose use in foods and beverages has been sanctioned by the U. S. Government) 10 The Pyronines 11. The Indamines, Indophenols, Thiazines, Oxazines 12 The Eurhodines and Safranines 13 The Quinoxaline, Quinoline, and Acridine Dyes. 14 Aniline Black 15. The Alizarine Dyestuffs. 16 Indigo. 17 The Sulphur Dyes 18 Mordants 19 Experimental Work. In point of publisher's technique the book deserves the highest praise, and there is a wealth of fully tried out structural formulæ. The treatment of the subject leaves nothing to be desired. A number of new prints an an occasional roughness in literary style should be eliminated by tension in a later edition. A curious omission occurs in the index, which, under the entry "Indigo," fails to give the most important reference, namely, that to the chapter on Indigo on page 375. The last portion of the book, pages 417 to 458, forms a laboratory guide for the preparation of some of the typical dyestuffs.

DICTIONARY OF ENGLISH AND SPANISH TECHNICAL AND COMMERCIAL TERMS. By William Jackson. New York: Spon & Chamberlain, 1911. 12mo, 164 pp. Price, $1.

An excellent idea is embodied in this neat little glossary, for it concerns itself with listing and interpreting the special terms of the iron, steel hardware, and engineering trades for the benefit of those who are engaged in ordering or in filling orders for these products between English speaking and Spanish speaking countries. As it is impossible to find many such technical names in the ordinary dictionary, this compilation should promote ease of commercial intercourse and find favor with a large class of buyers and shippers here and abroad. Between three and four thousand words and phrases are alphabetically listed.

HOW TO MAKE A WIRELESS SET. By Arthur Moore. Chicago: Popular Mechanics Company, 1911. 12mo; 84 pp., Illustrated. Price, 25 cents.

Boys all over the country are dabbling in "wireless," and many more will take up the hobby when they find how easily a short-distance outfit may be constructed. The instructions here given are for the making of a set that will transmit to a distance of four or five miles.

HOW TO LIVE IN THE COUNTRY. By E. P. Powell. New York: Outing Publishing Company, 1911. 8vo., 300 pp.; Illustrated. Price, $1.75 net.

Mr. Powell is well known as a prolific and sympathetic writer on rural subjects. He speaks from the fulness of an appreciative personal experience, and in this instance tells us how a large life may be lived on a small acreage. Both the dweller in the country and the city man who dreams of farm life may gain strength and breadth of outlook from the author's practical wisdom and inspiring description. The work is primarily a guide to choosing and making the most of a country home. The chapter entitled "Can we make it pay?" touches upon what is to most of us the vital point, and never while it encourages,

THE BOOK OF ROSES. By Louis Durand. New York: John Lane Company, 1911. 8vo.; 101 pp. Price, $1 net; postage, 8 cents.

The rose is everybody's favorite, symbolical of all the beauty and fragrance of life. Almost any soil can be made to grow roses of one kind or another. The various soils and their preparation forms the theme of the first two chapters. The question of planting is argued, and budding, sowing, and striking as methods of propagation are examined with thoroughness. Much space is given to describing the varieties—wild, autumn-blooming, decorative, and climbing roses. The full-page plates will delight the heart of the flower lover, for they seem almost to exhale the perfume of the specimens they picture.

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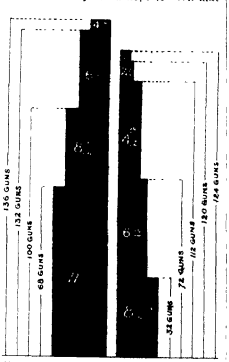
A Comparison of the German and American Navies

(Continued from page 78)

9¾, and ours from 9 to 12 inches—all Krupp armor. The upper sides of all these ships are protected by plates averaging 7 inches in thickness. But the American ships mount main batteries of modern 12-inch guns against the greatly inferior 11-inch weapon in the Teutons. The eight "Connecticuts" have each a broadside of four 12-inch 45-caliber rifles, which, as we have said, will send a shell through any plates the Germans carry, while the latter's 11-inch 40-caliber weapons are useless against more than 6-inch armor at 8,000 yards. And every one of the five "Georgias" and three "Maines" mounts four 40-caliber 12's which are effective at 8,000 yards against plates 8¾ inches thick.

The remaining ten "Wittelsbachs" and the older Americans are probably of too little offensive value to be seriously considered except for a second line of offense.

Certain it is, however, that the old 9.4's of the "Wittelsbachs" would be absolutely useless at ranges where the 13's of the "Alabamas," "Kearsarges" and "Indianas" could work fearful havoc with their 1,100-pound shells. The superior speed of the German vessels might indeed enable them to close in upon the Yankees, so as to give their guns a chance, but they would be fearfully punished before they could hope to even mat-



This diagram shows that the batteries of United States ships have far greater penetrative power than those of the German ships.

ters up in that way.

We have hitherto taken no account of the secondary batteries, because so great is the skill to which gun pointers have attained in recent years that it is doubtful if battleships would fight at ranges at which the lighter guns would be greatly destructive. It is true that they could even at a distance inflict much harm on the unarmored portions of the hull (fore and aft) and upper works, but almost all the complement of a modern battleship are stationed behind armor, and furthermore, the high trajectory of the 8's, 7's and 6's makes it more difficult to hit with them than with the larger pieces.

Armored Cruisers.

When it comes to armored cruisers the navies are more evenly matched. The splendid "Von der Tann" finds no counterpart on our list, more's the pity, and even the "Blucher" has some advantages over our "Montanas"—as in the matter of speed for example. But the rest of the Germans are a sorry lot, and our own "West Virginias" are not much better. As for the three "Charlestons"—they are hardly worth mentioning, being utterly useless from an offensive point of view.

In the matter of torpedo-boat destroyers, the Germans are much better off than we are. They have ninety-six of these ready for sea, ranging from the latest models of 620 tons and 34 knots speed to old and slow (25-knot) craft of 400 tons. We possess sixteen 400-tonners of 25 knots speed and twenty brand-new boats of 700 to 750 tons and upward of 31 knots speed.

On the other hand, the American navy has some twenty-six submarines to the German navy's eight; but this kind of craft is more especially adapted to the work of coast defense, and therefore need not be taken into consideration to any great extent.

In fast protected cruisers and gunboats the German navy has a considerable superiority over our own, but however useful the former may be as scouts for the fleet they cannot have any actual value in battle. Therefore we have left them out of our consideration of the relative strength of the two navies.

A summary of broadsides (for modern strategy points to the universal adoption of broadside firing in actions between fleets) of the various groups of battleships, as in the accompanying table, will show at a glance the immense superiority of the American ships in the ability to deal telling blows.

Herewith is given in graphic form a diagram showing the overwhelming superiority of the American battle fleet in the matter of heavy guns, 68, or exactly half of the total, being 12-inch rifles capable of successfully attacking at 8,000 yards the heaviest armor worn by the Germans. On the other hand, not a single one of the Kaiser's ships could at that distance pierce the main belt of any of the Americans, and only 32 of the newest rifles (11-inch, 45 caliber) would be effective against the Yankee topsides.

In time of stress it is the armored ships that count, and the tables given above demonstrate beyond peradventure of a doubt the present offensive superiority of the United States fleet.

Germany is contemplating equipping her newest dreadnoughts with ordnance of 12 2-inch caliber, but these undoubtedly powerful weapons will be more than compensated for by the new 14-inch rifles which are to be mounted in our "Texas" class, recently laid down. All this, however, is beside the question, as our object has been to demonstrate that at the middle of the year 1911, the German navy, far from being a menace, is not by any means the equal, offensively, of the fleet that flies the Stars and Stripes.

Heart Diagnosis by Electricity

(Continued from page 81)

the main circuit. This gives the various "derivations" or "leads" (1) Right arm and left arm, (2) right arm and left foot, (3) left arm and left foot. The wire from the left foot always goes into the same main wire and the left electrode occupies the same position in the circuit as the right arm does, otherwise an inverted electrocardiogram will be obtained. It is necessary to attend to these details, because some diseased conditions cause an inverted electrocardiogram. From the switches the two main wires lead to the galvanometer. In most instances when the patient is connected to the galvanometer, there is a large permanent difference of potential between the two parts of the body (so-called body-current) where the electrodes are attached. This deflects the fiber far to one side, and must be compensated. A commutator is placed in the circuit which serves the purpose of connecting in and sending in either direction around the main circuit a current from a battery (reduced to sufficient strength by a resistance coil). This is sent in the opposite direction to the "body-current," and serves to neutralize the primary body potential, and to effect what is called "compensation of the zero-current."

For making phonocardiograms simultaneously with electrocardiograms, the microphone is wired to a smaller galvanometer. The wiring of the microphone is simple. It is connected with a dry battery in a circuit with the primary of an induction coil. Wires from the secondary lead to the junction points of the wires from the galvanometer and resistance coil. The constant battery current passing through the primary induces no current in the secondary. Changes, however, in the strength of this primary current as the result of sound vibrations on the

Valuable Books

The Scientific American Cyclopedia of Formulas
Edited by ALBERT A. HOPKINS. Octavo, 1077 pages, 15,000 Receipts. Cloth, $5.00; half morocco, $6.50.

¶ This valuable work is a careful compilation of about 15,000 selected formulas, covering nearly every branch of the useful arts and industries. Never before has such a large collection of valuable formulas, useful to everyone, been offered to the public. Those engaged in any branch of industry will probably find in the volume much that is of practical use in their respective callings. Those in search of suitable articles which can be manufactured on a small scale will find hundreds of most excellent suggestions. It should have a place in every laboratory, factory and home.

Handy Man's Workshop and Laboratory
Compiled and edited by A. RUSSELL BOND. 12mo., 467 pages, 370 illustrations. Price, $2.00.

¶ This is a compilation of hundreds of valuable suggestions and practical ideas for the mechanic and those mechanically inclined, and tells how all kinds of jobs can be done with home-made tools and appliances. The suggestions are practical, and the solutions to which they refer are of popular occurrence. It may be regarded as the latest compilation of ideas of practical men published, and appeals to all those who find use for tools either in the home or workshop. The book is fully illustrated, in many cases with working drawings, which show clearly how the work is done.

Concrete Pottery and Garden Furniture
By RALPH C. DAVISON. 16mo., 196 pages, 140 illustrations. Price, $1.50

¶ This book describes in detail in a most practical manner the various methods of making concrete for ornamental and useful purposes. It tells how to make all kinds of concrete vases, ornamental flower pots, concrete pedestals, concrete benches, concrete fence, etc. Full practical instructions are given for constructing and finishing the different kinds of molds, making the wire forms or frames, selecting and mixing the ingredients, covering the wire frames, modeling the cement mortar into form, and casting and finishing the various objects. With the information given in this book, any handy man or novice can make many useful and ornamental objects to ornament the adornment of the home or garden. The information on color work alone is worth many times the cost of the book.

The Design and Construction of Induction Coils
By A. FREDERICK COLLINS. Octavo, 295 pages, 159 illustrations. Price, $3.00.

¶ The work gives in minute detail full practical directions for making eight different sizes of coils, varying from a small one giving a one-half-inch spark to a large one giving twelve-inch sparks. The dimensions of each and every part down to the smallest screw are given, and the directions are written in language easily comprehended. Much of the matter in this book has never before been published as, for instance, the vacuum dryers and impregnating apparatus for the wax, the paraffine wax condensers, the construction of interlocking reversing switches, the set of condensers using diagrams, etc. The illustrations have all been made from original drawings, which were made especially for the work.

Industrial Alcohol Its Manufacture and Uses
By JOHN K. BRACHVOGEL, M.E. Octavo, 328 pages, 107 illustrations. Price, $4.00

¶ This is a practical treatise, based on Dr. Max Maercker's "Introduction to Distillation" as revised by Dr. Alexander and Lange. It contains raw materials, malting, mashing and yeast preparation, fermentation, distillation, denaturing and purification of alcohol, alcoholometry, the value and significance of a tax-free alcohol, methods of denaturing, its utilization for light, heat and power, production, and a statistical review and the United States law. This is one of the most authoritative books issued on the subject and is based upon the researches and writings of the most eminent of Germany's specialists in the science of fermentation and distillation. It covers the manufacture of alcohol from all raw material in the most modern and purified product, including chapters on denaturing, domestic and commercial utilization.

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microphone, set up induced currents in the secondary, and these are recorded by the galvanometer.

In healthy people the electrocardiogram assumes, in the majority of instances, a certain typical form. The term "typical" or "schematic" is used instead of "normal," since slight deviations from it may occur in people with normal hearts. When any muscle is excited to contract, the active portion is always electrically negative to the part at rest. This is true, therefore, in the heart, and electrical changes show the course of excitation. The curve for each heart period presents throughout three principal waves upward, indicating an electrical negativity of the base of the heart with regard to the apex at three different instants in a single cardiac cycle. These three elevations have been designated by Einthoven as *P, R,* and *T*. The curve presents, also, in many instances, two slight excursions or waves downward, depressions, indicating a negativity of the apex of the heart with regard to the base at two different instants in each cardiac cycle. These two depressions, though less constantly present than the three elevations, have been designated by Einthoven as *Q* and *S*.

By the course and height of these waves, as shown in the records, the physician can tell by eye whether the heart undergoes normal electrical changes or abnormal, in the latter instance an analysis of the abnormal appearances of the record throws light upon the disease of the heart-muscle which is present.

The two accompanying illustrations will give a clearer conception of the method of observation. The upper of the two diagrams is an electrocardiogram. The lower is a diagram, on an enlarged scale, of a section of the electrocardiogram, which will make plainer the changes in a single cardiac cycle. Waves with the apex upward indicate that the base of the heart or the right ventricle is negative to the apex or left ventricle, and is therefore excited at that time. Waves with the apex downward have an opposite significance. Wave *P* is due to the excitation of the atrium (or auricle). Waves *Q, R, S* and *T* occur during the excitation of the various portions of the ventricle.

What this instrumental investigation signifies not only for the discovery of disease, but also for diagnosing its precise character, it is as yet too early adequately to judge but many physiologists and physicians believe that it will prove to be a very valuable aid to the medical profession. While the galvanometer, the photographic recorder and the auxiliary instruments have in this country already furnished data of importance in connection with animals as well as human beings, the work in Europe has been far more extensive, as a larger number of stations have been established.

Light-producing Bacteria and Fireflies

A FEW years ago Prof. Molisch determined that of all the light-producing bacteria *Pseudomonas lucifera* produced the brighest light. F. Alexander McDermott presented before the Biological Society of Washington the results of his own further experiments with this organism. A culture of these bacteria was sent to Washington by Prof. Molisch, so that the form used was identical with the original material.

Mr. McDermott finds that the bacteria will grow in gelatin or a liquid medium, doing better however in gelatin; in all cases it needs the presence of from 2.5 to 3 per cent of common salt, or certain other mineral. A culture will continue to give off light actively for about a week, reaching the maximum 48 hours after inoculation. The light is a soft green of "considerable intensity." The following formula furnished the best culture medium: Peptone, 1 per cent, Asparagin, 1 per cent, Magnesium chloride 0.5 per cent, Sodium chloride 2.5 per cent, Glycerine 0.5 per cent.

Solutions of greater concentration were not so favorable to the growth of the bacteria, and Mr. McDermott suggests that the organism is "apparently sensitive to overfeeding." It is perhaps simply an indication, however, of the osmotic limits of the minute cell.

The spectrum of the light emitted runs from yellow-orange to indigo and is less constant than the light from certain fireflies, though similar in appearance to the naked eye. Although the light from cultures in a liquid medium looked whiter to the eye, the spectrum was the same.

The luminous tissue of fireflies had already been shown capable of again emitting light when moistened, after having been dried in a hydrogen vacuum - even after the lapse of from thirteen to eighteen months. It had also been found that the light was brighter when the tissue was moistened with hydrogen peroxide solution. Similar results are now reported for dried cultures of *Pseudomonas*. Oxygen under pressure also restored the luminosity.

The general character of the light produced by the firefly and by these bacteria is the same, but there is no reason to suppose that the process by which it is produced is the same in the two cases. But it is probable that the luminosity is connected with oxidation in both organisms.

The Current Supplement

THE opening article of the current SUPPLEMENT, No. 1855, deals with the Grand Trunk Transcontinental Canadian Railway.—Major George O. Squier's paper on Multiplex Telephony and Telegraphy is continued.—The heat-insulating efficiency of vacuum-jacketed bottles is discussed by A. A. Somerville.—Command ant Renard's paper on "What Constitutes Superiority in Airships" is concluded.—Before the Society of German Marine Engineers the contributions of Goethe to science and industry are considered.—Jacques Boyer writes on the application of the Dussaud principle of illumination to moving picture projection.—The Berlin correspondent of the SCIENTIFIC AMERICAN describes an apparatus for recording loss in weight.—The possibilities of aeroplanes in naval warfare are discussed by a German naval officer.—Illustrated descriptions of automobile novelties are presented.—Ralph C. Davison writes on the enormous discharge of dynamite rendered necessary in the construction of the new cut-off of the Delaware, Lackawanna and Western Railroad near Andover, New Jersey.—A good article on toxicology is contributed by Professor Levin, of the University of Berlin.

The Secret of the Maple

IT is probable that every observant person who has visited a maple grove in the early spring, while snow banks are yet lingering in sheltered hollows, and has seen pailful after pailful of sweet sap drawn from the auger-holes in the trunks, has wondered what forces govern the flow of the sap.

When the warm sun touches the treetops the flow increases. A rise of a few degrees in temperature often causes a great increase of flow, if the rise passes the zero point, on the Centigrade scale, that is, the freezing-point of water. But a considerable change of temperature in which the fluctuations do not cross the zero line causes no marked change in the flow of the sap. In the consideration of these and other related facts, the conclusion has been reached that neither expansion of gas in the wood nor expansion of water, nor expansion of the wood itself, is the underlying cause of the pressure which produces the flow, but that this pressure arises from the effects of temperature in altering the osmotic permeability of the pith-ray cells.

A New Route Across Africa.—The German Government is rapidly progressing with the railroad that is to connect Daressalam with Tabora in German East Africa. A force of 10,000 laborers is at work on the new road, of which 374 miles have been constructed. According to the *Deutsch Ostafrikanische Zeitung* the ultimate extension of this road to Ujiji, on Lake Tanganyika, is practically assured. As the Belgians have now decided to extend their upper Congo railway system to the west shore of Tanganyika, the time is not far distant when it will be possible to travel by rail, lake and river across Africa from Daressalam to the mouth of the Congo.



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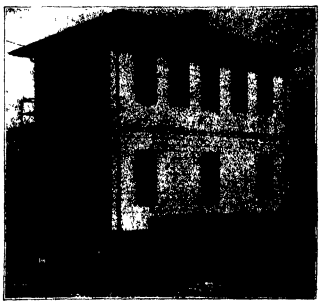
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CONSERVATION

The AUGUST Magazine Number of the SCIENTIFIC AMERICAN Issue of AUGUST 12th, 1911

The next magazine number of the Scientific American, August 12th, 1911, will contain a series of articles by leading authorities, which will deal with this vital subject of the conservation of our natural resources.

Ex-Chief Forester the Hon Gifford Pinchot, whose earnest fight for the preservation of the coal lands of Alaska has led to a favorable decision of the Land Office, which greatly strengthened the cause of conservation, will open the number with an article on the Conservation of our Forests.

The Director and Chief Engineer of the Reclamation Service, F. H Newell, will write a general article on the past work and future plans of the Reclamation Service.

The Director of the Bureau of Mines, Dr. Joseph A. Holmes, will show that the waste of our supplies of coal is due not merely to careless and extravagant management in the mining of the coal, but also and very largely to methods in burning the fuel.

Dr. David T. Day, of the United States Geological Survey, will prove, in an article on the conservation of oil and gas, that, as with coal, so with oil and gas, it is possible to effect large economies by judicious management in the oil and natural gas fields and by the use of improved appliances in burning these fuels either for light or power purposes.

Dr. Hugh M Smith, Deputy Commissioner of Fisheries, will contribute an article on the Conservation of Fish, Oysters, etc., and Seals. Conservation is a word to which we are liable to give too restricted an application.

In addition to the above articles, the August 12th number will contain the usual Editorial, Aviation, and other Departments.

Electricity

Unloading Bananas by Electricity.—Fruit steamers in New Orleans and Mobile are now being unloaded by means of electric conveyors. The conveyors are provided with vertical legs that enter the hatches of the vessel. These legs support traveling chains four feet apart, which are connected by cross bars carrying canvas pockets Bunches of bananas are placed in these pockets and hauled out of the vessel The loading of the conveyor is performed from three decks, each deck filling every third bag. Each conveyor has a capacity of twenty-five hundred bunches of bananas per hour.

Avoiding Pole Lines in a Welsh Town.—In order to avoid the use of poles in the streets of a town in Wales, it was decided to run the wires on brackets supported on the sides of the buildings and the roofs The brackets are made of angle iron and extend about six feet from their support At first there was some hesitation on the part of owners about giving the right of way over and along their buildings, but this was overcome by proper precautions on the part of the company The system has proved very successful, and it avoids crowding and disfiguring the streets with poles

Outdoor Ironing.—One of the most dreaded days of the household in summer time, is ironing day Even though electric flat irons are used, the heat may become almost unbearable owing to the fact that the work is invariably done indoors. The Commonwealth Edison Company of Chicago does not see why the ironing should not be done outdoors on the porch, or in some other convenient location All that is needed is a sufficiently long conductor to connect the flat iron with a lamp socket in the house This idea has been seized upon to provide a very attractive circular showing the advantages of out door ironing and incidentally advertising the use of electricity for this branch of the house work

Electric Fans for the Sick.—According to popular impression public service corporations are organized robbers It is almost impossible to combat this prevailing idea Recently, however, the Electric Supply Company of DeKalb, Ill., has demonstrated that it can perform a work of charity in which there is no personal gain whatsoever, except for creating a better feeling on the part of the public toward it The company has notified all the physicians in the city that it will furnish electric fans and power to operate them without charge, to all patients who are unable to pay for such service and who, on the suggestion of the physician would be materially benefited by the use of fans This applies not only to such houses as are wired, but to others as well the company offering to install the necessary circuits, gratis

New Lighting Apparatus.—A very economical method of producing light by means of small incandescent lamps was shown by M Dussaud before the French Academy of Sciences He mounts 16 small lamps with one-inch bulbs around the edge of a revolving disk, provided with a set of contacts so arranged that when the disk rotates each lamp receives current for a fraction of a second. It is well known that tungsten lamps have the property of lighting up very quickly when the current is applied. He uses a 10-volt lamp and it receives 20 volts, or much more than the normal current, but for a very short time Much more light is thus given for the same amount of current Each lamp in turn passes when lighted before a fixed lens so as to project the rays, and as the lamps pass rapidly the light seems continuous His main object is to provide a suitable light for lantern projections, and he claims to secure a light equal to an arc lamp for a very small current such as a moderate-sized primary battery will give Thus it can be used where there are no current mains at hand. It is well adapted to be used as a small searchlight upon fishing boats or to be carried by soldiers, and for army use the battery can be placed in a sack upon the shoulders, together with an optical signaling outfit. Such an outfit can be used also perfectly diminishing the illuminating [illegible]

Science

Death of G. Johnstone Stoney.—Dr. G. Johnstone Stoney died recently at the age of 86. He had been astronomical assistant to the late Earl of Rosse in 1848, professor of natural philosophy in Queens University, Ireland, in 1852, and secretary of Queens University from 1857 until its dissolution in 1882. He was known chiefly for his writings on astronomy.

An Opera Glass Comet.—We have received a communication from Prof. Edward C Pickering of Harvard College Observatory, in which he states that a comet has been discovered by Kiess on July 6th in R A. 4 h 51 m. 51.8 s., Dec. 35 deg. 15 m 2 s. The comet can be seen with an opera glass, and at the time of its discovery was moving southwest and had a visible tail.

Color Photography.—A patent, 992,151, has been issued to Rodolphe Berthon of Lyon, France, for a color photography apparatus which comprises an objective with a diaphragm therein having a trichromatic screen, a sensitive surface and means interposed between the sensitive surface and the objective so that the images on the screen are separated by refraction at points in close proximity and projected in a microscopic state on the sensitive surface.

The "International Week" of Upper Air Observations.—A circular from the headquarters of the International Commission on Scientific Aeronautics announces that, owing to the fact that the attention of British as well as many foreign meteorologists will be taken up with the meeting of the British Association during the early part of September, the dates set for the "international week" of aerological observation throughout the world, in 1911, have been changed from September 5-9 to September 11-16.

A Meteorological Outpost in the South Atlantic.—An important addition to the meteorological *réseau* of the southern hemisphere was made early this year in the establishment of a meteorological station of the first order in Fernando de Noronha, a little group of islands about 194 miles northeast of Cape St Roque, on the Brazilian coast The islands are used by Brazil as a penal colony, and contain upward of two thousand in habitants Darwin has described a visit here in the "Beagle," and the "Challenger" also touched here The station is under the charge of two German employees of the Brazilian telegraph service, and sends daily telegraphic reports to Rio de Janeiro.

The Flight of Seeds.—It is popularly believed that winged seeds from trees travel to great distances on the wind, but the investigations of a British scientist, who has spent much time at Singapore, indicate that winged seeds have a far narrower range of flight than have "powder" seeds and plumed seeds The greatest distance traveled by the winged seeds of a forest tree observed by this authority was 100 yards Under the most favorable circumstances, he calculates, it would take this plant just one hundred years to spread three hundred yards, and 1,500,000 years to spread from the Malay Peninsula to the Philippines, if a land connection existed.

Illumination with Neon Tubes.—M. Ch. Ed. Guillaume recently lectured before the Astronomical Society of France on the subject of neon light. Neon, one of the rare gases of the atmosphere, is now obtained on a commercial scale in the process of making liquid air. In a vacuum tube it has several excellent qualities as an illuminant Owing to its extraordinarily feeble dielectric cohesion the voltage required is relatively small. M. Guillaume exhibited a tube six meters long, which was illuminated with a current of 1,000 volts. A light of 1,330 candle-power was produced, with an expenditure of only 850 watts, or 0.64 watt per candle-power. The light, which is of a warm golden yellow, is described as being peculiarly pleasing. The lecturer also described a process of removing from the tube traces of other gases, especially nitrogen, the presence of which [illegible]

SIXTY-SEVENTH YEAR

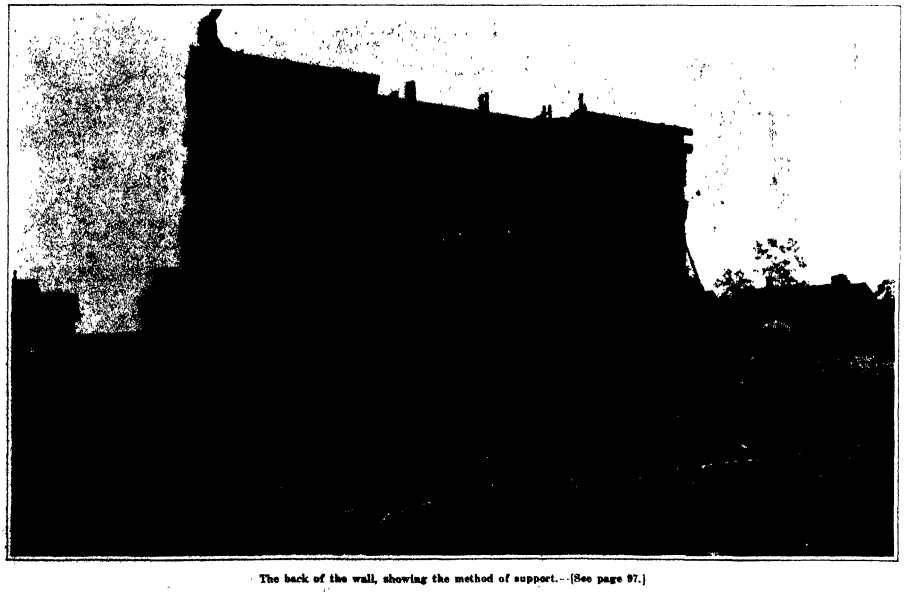
SCIENTIFIC AMERICAN

THE WEEKLY JOURNAL OF PRACTICAL INFORMATION

VOLUME CV NUMBER 5] NEW YORK, JULY 29, 1911 [10 CENTS A COPY $3 00 A YEAR



Lifting the church wall in place by means of jacks.



The back of the wall, showing the method of support.—[See page 97.]

BUILDING A CHURCH FLAT ON THE GROUND IN SECTIONS

SCIENTIFIC AMERICAN

Founded 1845

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The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. Drawings or photographs of striking subjects are desired, and the facts stated in the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

The purpose of this journal is to record accurately and in simple terms, the world's progress in scientific knowledge and industrial achievement. It seeks to present this information in a form so readable and readily understood, as to set forth and emphasize the inherent charm and fascination of science.

Good Roads That Are Permanent

CHIEF among the qualities of a good road is that of durability, and durability can be assured only by first-class work in construction and by ceaseless vigilance in maintaining the road in perfect condition. It goes without saying that the highways of America, considered as a whole, are not to be compared with those of the older European countries. After a motor car tour through Europe, the returning American becomes painfully aware of the fact that in this most important matter, his countries, even if we allow for its comparative youthfulness, in many decades behind that stage of development to which its wealth and enterprise should have carried it long ago. Although we say this with full appreciation of the fact that some of our States, and notably New Jersey and Massachusetts, have done effective work in building up a system of highways, the fact remains that, taken as a whole, the United States has not done much more in this matter of good roads than make a beginning. The work has yet to be done.

It is not that we have been parsimonious in the matter of appropriations. Had the money which has been voted by legislatures and county boards, and the enormous amount of work which has been done under the assessment method, been expended wisely in the first place, and followed up by intelligent methods of maintenance and repair—in other words, had we built our roads and cared for them as they build and maintain them in Europe, we do not hesitate to say that for the money and energy expended, our roads would have been in at least one hundred per cent better condition than they are today.

The fundamental requirements of a good road are an ample foundation and good drainage. Without these, the most carefully leveled and smoothly rolled top surface is nothing more than a delusion and a snare. Furthermore, a road which has been built with deep foundations, good drainage and an ample depth of suitable top dressing—unless it be watched and tended with the most solicitous attention—will go to pieces only a little less rapidly than the cheap product of the scraper and horse roller.

We have long believed that in those districts where scarcity of travel and financial inability to provide the necessary funds prohibit the construction of a first-class macadam road, it would be better to invest the time and money in constructing short sections of durable road, leaving the traffic to fight it out with "chuck holes," deep ruts and mud over the balance of the highway during the winter months. The endurance of a few years of discomfort would be repaid by the ultimate possession of a permanent first-class highway. Moreover, the use of oil or some other of the many excellent "binders" that are now available would make it possible to maintain the unimproved roadway in as good it not better condition than that of the old scraper-and-roller highway, which invariably went to pieces after the first two or three frosts and rains of the winter.

In districts where financial conditions and the amount of traffic has warranted the construction of expensive roads, millions of dollars have been thrown away because of the absolutely absurd system of maintenance (if it can be called such) which has been followed. There is no method of construction upon which eternal vigilance is so necessary as on that of the modern macadam highway. This has long been recognized in Europe, where the roadways are divided into comparatively short sections, each of which is controlled by a section gang, provided with a supply of broken rock, gravel, sand, or other road mending material, conveniently distributed in piles along the roadway. Each member of the gang has his wheelbarrow, pick and shovel, and as soon as the slightest indication of breakdown, such as a rut or hollow, is detected, repairs are made before the damage can proceed any further. A century of experience has proved that this is the only way in which a road can be maintained always in absolutely first-class condition, never was the truth of the old adage "A stitch in time saves nine" more strikingly true than in this matter of the upkeep of public thoroughfares.

Sound in the Universe

WE live and move at the bottom of an ocean of air, the earth's atmosphere. One consequence of this is that every mechanical disturbance starts waves of compression and rarefaction, which radiate out from the source, and, striking the drum of our ear, may (if of the right strength and quality) cause in us the sensation of "sound." Among such sensations some affect us merely as "noises", in others we recognize a more or less well-defined "musical pitch" and "tone quality." Physically the "noise" differs from the "musical note" in that the former is an irregular disturbance, while the latter is periodic and of definite frequency. Not that there is any hard and fast line of demarkation, a rapid succession of impulses, which separately would be mere noises, may impress the ear with a definite sense of pitch. Thus the teeth of a saw, cutting in rapid sequence through a wooden board, produce a sound of definite pitch, though lacking perhaps in musical quality. Or again, a sharp noise of brief duration, proceeding from a point in the neighborhood of a series of equidistant obstacles, such as a line of fence-rails, or a flight of stone-steps, produces upon the observer a sensation in which a more or less well-defined pitch can be recognized. The explanation of this phenomenon is that the sound is reflected back from each fence-rail in turn, and since it takes time to travel, each echo reaches the observer a trifle later than that from the neighboring rail. This case is of special interest, because the sound "heard" contains an element quite foreign to the initial disturbance. Furthermore, the pitch of the sound heard differs according to the location of the observer, so that, borrowing an expression from optics, it might be said that the original disturbance is "analyzed" by reflection from the fence (grating) into its "constituent" waves—each traveling in its own direction, so that it can be singled out by the observer. It is possible that the means commonly employed to analyze light waves act in this way, and perhaps we are not quite justified in imagining "white" light for instance as "composed" of the various spectral colors, these being rather impressed upon it by the prism or grating or other device employed to analyze" the light, as we commonly say.

Of all the forms of energy, sound would probably be of the least consequence to man, were it not for the one important fact, that sound is the normal vehicle for the transmission of intelligence between individuals. Certain special sounds are recognized by us not merely as "noises," or "musical notes," but as "words," which are associated in our minds with definite concepts, and whose mere mention immediately summons up before our imagination the concepts thus attached to them. Not that speech exhausts all the modes of sound-expression for mental states at our command. Indeed, more elemental and lower in the scale than speech are various inarticulate sounds, such as laughter and crying, calls of various kinds, the groan of pain the sigh of relief, the shriek of fear, and a host of other emotional expressions. In these man approaches more nearly to the lower animals, who also possess "calls." But the range of our modes of expression by means of sound extends also on the other, the heroic side, beyond ordinary speech. The poet by rhythm and cadence conveys something more than his words alone would say, and in the symphonies of the great masters of music there is borne in upon us a wealth of thoughts that lie too deep for words.

If the ocean of air which envelops us is the medium that carries sound to our ears, and thus places us in sentient communication with the other occupants of this globe, its shore, the void upon which the upper atmosphere abuts, is also the extreme limit of the range of space comprising all things audible to us. No sound, however loud, can ever pass from the earth into space beyond, neither can it penetrate from other orbs to us. The sun's burning eye looks down on us in splendor mute; for though his fiery ocean be lashed by furious gusts, in comparison with which the fiercest earthly gale is but as the soft sighing of the autumn wind, or as the breath of one that slumbers, and though monstrous explosions rend his very bowels, belching aloft great pillars of fire that tower thousands upon thousands of miles, yet of all the crash and thunder and tumult not a whisper escapes to break the eternal silence of infinite space, and the empty void holds close the clamorous secret of the fiery orb.

Seismology in America

THE United States has heretofore lagged behind most other civilized countries in the cultivation of the science of earthquakes, and to this day there is no chair of seismology or department of seismology in any American university.

Shortly after the San Francisco earthquake of April, 1906, a number of scientific men on the Pacific coast organized the Seismological Society of America, which now has a large membership well distributed over this continent, and beyond. We are glad to record the appearance, beginning with last March, of the quarterly *Bulletin of the Seismological Society of America*, published at Stanford University. In the initial number of this publication Prof. Andrew C. Lawson gives a timely review of the status of seismology in this country; while elsewhere in the *Bulletin* appears a list of all the seismographs known to be in operation in North and South America and the West Indies. Probably few scientific men realized how numerous these instruments have become on this side of the Atlantic. Forty-three are enumerated within the United States. The Jesuit colleges are especially notable for the zeal with which they have extended and organized such installations.

Prof. Lawson appeals to the Carnegie Institution to undertake the direction of seismological work in America. At present such work lacks organization, and the seismological stations are badly distributed, they are crowded in some sections and very sparsely distributed in others. The attitude of the government toward seismology is strangely at variance with its general policy in regard to other branches of science. It was proposed a few years ago to equip a number of stations of the Weather Bureau with seismographs, and this proposal was urged upon Congress by a committee of the American Association for the Advancement of Science. As the Bureau has some two hundred regular meteorological stations scattered over the country, manned by paid employees, the additional expense entailed in adding seismological work to its duties would not be considerable, and such an addition would be in accord with the policy of most foreign countries, where seismological observations are generally made under the direction of the official weather services. In spite, however, of the urgent recommendations of the Chief of the Weather Bureau in behalf of this proposal, it was rejected by Congress, and the Bureau possesses, up to date, only the seismograph installed at its central office in Washington.

Another appeal was made to Congress last year to establish a bureau of seismology under the Smithsonian Institution. Although the bill introduced to this effect carried with it an appropriation of only $20,000, it never passed the committee stage in Congress.

It might be supposed that the State of California, after its painful experience of 1906, would be liberally disposed toward the science that has for its practical aim the amelioration of the effects of earthquakes, but such is not the case. It is practically impossible to secure State aid to seismological investigations in California because the commercial spirit of the people fears that such investigations would advertise California as an earthquake region and hurt business.

We are not in a position to say what attitude the Carnegie Institution will take toward Prof. Lawson's proposal that it take over the national control of seismology. Such action would, however, be a departure from the settled policy of the Institution, which is opposed to the assumption of duties that properly belong to the national government. That the study of earthquakes falls within this category cannot be doubted.

The Guardian of Ninety Million Stomachs

Dr. Harvey W. Wiley of the Bureau of Chemistry

By William Atherton Du Puy

BECAUSE one man saw a great light, because he was a great scientist, a great politician, a great philosopher, a great fighter, a great publicity agent, the ninety million have come to have dependable food on their tables three times a day. Because this man lived and fought, the babies of a nation are no longer drugged into degeneracy and death. Because of his activities the adults of a nation are no longer unknowingly acquiring drug habits that sap their vitality. Because of the standard his influence has set in the matter of pure foods and drugs a new spirit is abroad in the land which promises to put all lines of business on a basis of honesty that they have never known before.

For Dr. Harvey W. Wiley, chief chemist of the Department of Agriculture, has so wrought as to bring to bear upon the every day lives of all the people an influence among the greatest of any man of his time. He has a theory that the man of to-morrow is a product of what goes into his stomach to-day. He set out long ago to make better men through giving them better food and preventing the injuries that were being done them through deceptive drugs. He has encountered stupendous difficulties.

And now, suddenly, his enemies execute a coup that was intended to prove his undoing. He is charged with irregularity in the employment of a necessary expert at a salary of $1,600 a year. It is recommended that because of this alleged irregularity all the accomplishments of his thirty years of labor be set aside and that he be summarily dismissed.

But the ninety million have insisted on being heard from. They have arisen *en masse* and have used every organ at their disposal in voicing their displeasure at the proposal to remove the pure food expert. There never was a salary of $1,600 paid to an expert, legitimate or otherwise, that so aroused a nation or promised so many embarrassments to men high in public life.

All this calls particular attention to Dr. Wiley, whose activities have been a matter of comment for a quarter of a century, whose personality has given him a position that is unique, yet whose enemies, though few, are powerful, for the money of all the illicit business he has disturbed is back of them.

Dr. Wiley is an interesting character. His father was an Indiana farmer of Scotch descent who mastered Greek unaided and preached thirty years without pay. His son grew up on a farm and became the champion corn planter of the neighborhood. He paid his way through Hanover College with money he earned doing manual labor on the farm. Later he taught and saved money for a year at Harvard, then taught at Purdue. He became State Chemist in Indiana and in 1882 investigated maple sugar adulterations, one of the first food investigations the United States knew. The following year he was made chief chemist of the Department of Agriculture, a position so obscure that its only duty was passing upon the mixture of fertilizers. This was twenty-eight years ago and with the growth of the Bureau of Chemistry from fertilizer mixing to the supervision of the foods and drugs of a nation has been the growth of Wiley, for he has been the Bureau of Chemistry.

Dr. Wiley is now a man of sixty-eight years of age, a great, hulking man, six feet tall, weighing 220 pounds, in perfect health and apparently twenty years younger than he is.

Soon after Dr. Wiley became associated with the Department of Agriculture he began his pure food investigations. In Indiana had been born an ambition which was nothing less than giving the people of the nation honest food. Everywhere there was deception in the things that were sold. If one bought pepper it was eighty per cent ground up shells. If one bought meat it was "embalmed." If one bought fruit it was pickled in injurious chemicals. If one bought proprietary medicine it might have any amount of opiates in it without his knowledge. There was no dependence to be placed in labels and names. Wherever money was to be made through deception, deception was being practiced. The whole people bought, as food, substances with little nourishment in them. More than that, they were being deceived into putting things into their stomachs that were cryingly injurious to them.

The people did not know this. They were busy with other things and little interested in being told. Even when convinced they did not know what to do about it. They had to be informed, interested, and led to act. It is no mean task to lead the public through these stages. But Dr. Wiley was the man with the particular qualities to accomplish these things. In the first place he was thoroughly aroused over the food question. In the second place he was willing to work night and day, year after year, on this one job. In the third place he had the happiest faculty of the publicity man that has ever been bestowed to an individual.

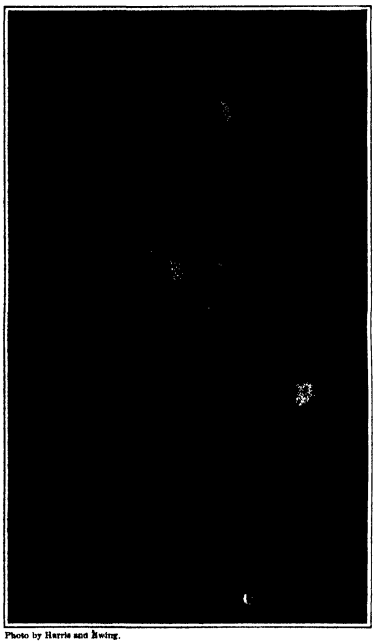


Photo by Harris and Ewing.

DR. HARVEY W. WILEY

The chief of the Bureau of Chemistry of the Department of Agriculture.

Dr. Wiley's greatest asset in his campaign for pure foods has been his ability to get into the papers. He is the most sociable man on earth. He is an artist as an after-dinner speaker. He is a clubman. He accepts many invitations, especially where there is a chance to make an after dinner speech. Then he talks for the newspapers chiefly about pure food. He has the gift of talking in headlines. There is an epigrammatic sensation in every one of his speeches. He always makes a "story" that gets on the front page, a "story" that calls public attention to some food abuse. The same is true when he talks to reporters. There is not a newspaper man in Washington who does not fall back on Dr. Wiley whenever he has failed to get something to write elsewhere. It was through publicity that he finally got his message to the masses. They came to know the dangers that beset them through the food they ate, and they came to understand the possibilities of removing these dangers. The campaign of publicity finally ended in the passage of the Pure Food and Drug Act of 1906, which was put in operation under the guidance of the chief of the Bureau of Chemistry on January 1st, 1907.

But with the passage of the law the troubles of the chief chemist were but just begun. Previously his campaign had merely been educational. Now it was administrative. The blacklisting of a given drug or a given food meant the antagonizing of the interests back of that food or drug. Millions had been made in the manufacture of patent medicines that made their reputations for cures by the soothing effects of the opiates they contained. Those millions were to be destroyed by the prohibitions of Wiley. Other millions were being made in an adulteration of various foodstuffs and by their preservation with injurious chemicals. The public was being tricked by the use of dyes and coloring matters. Fortunes were made by branding an inferior article as something better. In the aggregate it is estimated that $400,000,000 in invested capital was arrayed against this one man. That capital was determined to destroy him. His position was political. Big money is prominent in politics. It has long played politics in an attempt to get rid of Wiley.

A trial involving the use of a food preservative was recently held in Indianapolis. Dr. Wiley was refused permission to go to Indianapolis to testify. The court sent a committee to Washington to get his affidavit.

"Do you realize," Dr. Wiley was asked, "that the defendants in this case represent an investment of $10,000,000?"

"Probably so," responded the chief chemist, "but if there was at stake the life of but one baby instead of thousands, I would place that life above the interest of the capital invested."

The Wonderful Mechanism of the Watch

FEW pieces of machinery show more marvelous features than that of the watch. As a general proposition it may be stated that a watch is the smallest, most delicate instrument of the same number of parts that has ever been devised. About one hundred and seventy-five different pieces of material enter into its construction, and upward of twenty-four hundred separate operations are comprised in its manufacture.

Certain of the facts connected with its performance are almost incredible when considered as a whole. A blacksmith strikes several hundred blows on his anvil in a day and, as a matter of course, is glad when Sunday comes, but the roller jewel of a watch makes every day—and day after day—432,000 impacts against the fork, or 157,680,000 blows during the course of a year, without stop or rest—or some 3,153,600,000 blows during the space of twenty years, the period for which a watch is usually guaranteed to keep good time.

But the wonder of it does not cease here. It has been calculated that the power that moves the watch is equivalent to only four times the force used in a flea's jump. The watch power is, therefore, what might be termed the equivalent of a four flea power. One horse power would suffice to operate 270,000,000 watches.

Furthermore, the balance wheel of a watch is moved by this four flea-power one and forty-three one hundredths inches with each vibration, or 3,558¾ miles continuously in one year.

Not much oil is required to lubricate the little machine on its 3,500 mile run. It takes only one-tenth of a drop of oil to oil the entire machinery of a year's service.

Lung Capacity as Affected by Corset-wearing

THE lung capacity of the average woman who does not wear corsets is about 2800 cubic centimeters or 171 cubic inches, of one who is in the habit of wearing corsets only 2,200 cubic centimeters or 134 cubic inches, so that the capacity of the normal and unrestricted lungs is about 27.3 per cent more than that of those which have been compressed by the corset.

The Battleship "Utah"

Our Latest Dreadnought

THE work of upbuilding our modern navy goes on apace. Although the progress is not as rapid as some of us could wish, in quality we are more than holding our own, for what we lack in numbers we gain in gun power and in the high quality of the personnel.

We present an illustration of the latest of our dreadnoughts, the "Utah," which, with her sister ship, the "Florida," now approaching completion at the New York Navy Yard, represents an advance in many important particulars, on the "Delaware" and "North Dakota." The illustration is from a photograph taken during the recent speed trials of the "Utah" over the Government course at Rockland, when she considerably exceeded her contract speed of 20.75 knots, the maximum average speed being 21.8 knots.

The "Utah" was authorized by Congress on May 13th, 1908. The contract for her construction was let to the New York Shipbuilding Company at Camden, N. J. on November 24th, 1908. Her keel was laid March 15th, 1909. She was launched December 23rd of the same year, and the contract date for her completion was July 24th, 1911. She will probably be delivered over to the Government early in August.

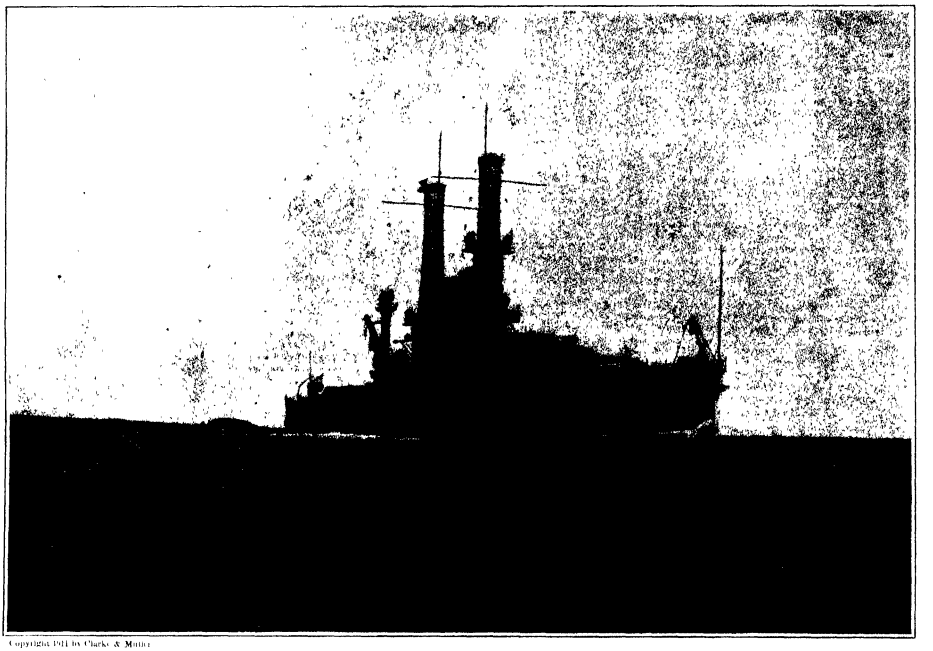
It will be noticed that in her general appearance she conforms closely to the "Delaware" and "North Dakota," having two cage masts, two funnels, and mounting ten 12-inch guns in five turrets placed on the longitudinal center line. Two of the turrets are placed forward of the conning tower the guns of the after turret firing above the forward turret, the ship being thus able to fire four 12-inch guns dead ahead and through a wide arc of training on either beam. The three remaining turrets are placed aft of the mainmast, the foremost of these three being carried to an elevation sufficiently higher than the after two turrets to enable its pair of guns to fire above their roofs, thus giving a concentration dead astern and through a wide arc of training on each beam of four 12-inch guns. Because of the center line position of all the turrets, the whole battery can be trained through an unusually wide arc on either beam of the vessel.

The "Utah" is 521½ feet in length over all, or about 3 feet longer than the "Delaware," and she exceeds that ship in beam by 3 feet, the "Delaware" being 85 feet 2½ inches broad, and the "Utah" 88 feet 2½ inches. She also draws about a foot and a half more water at her mean draft, which is 28 feet 6 inches. As the result of this enlargement, her displacement at normal draft, when she is carrying two-thirds of the full supply of stores and fuel, and a full supply of ammunition, is 21,825 tons, as compared with 20,000 tons displacement of the "Delaware" when she is carrying two-thirds of her full supply of ammunition and stores. When fully loaded her displacement is 23,033 tons.

The "Utah" is driven by Parsons turbines whose power is delivered to four propellers. The contract called for a speed of 20.75 knots, with 28,000 horsepower, but on trial, as we have seen, she exceeded this by fully one knot. Her bunker capacity is 2,500 tons of coal, exclusive of 400 tons of oil fuel.

The defensive elements of the "Utah" are unusually complete. The main belt is 7 feet 11½ inches wide, extends 6 feet 6 inches below the water line, has a thickness at the top of 11 inches, and at the bottom of 9 inches. The upper belt, which extends to the gun deck, has a thickness of 10 inches at the bottom, and 8 inches at the top. The casemate armor is 6½ inches in thickness, and it is associated with 1½-inch splinter bulkheads. The barbettes are protected by 11 inches, and the turrets by 12-inch front and 8-inch side armor.

The battery consists of ten 50-caliber, 12-inch guns, and sixteen 5-inch, 50-caliber guns for protection against torpedo boat destroyers and torpedo boats. There are two submerged torpedo tubes, for the discharge of the new high-speed 21-inch torpedo, which has an effective range of over 4,000 yards. An important feature in these ships is the good command of the guns, due to the sufficient freeboard of the ship. Forward, the freeboard of the "Utah" is about 26 feet, and aft about 18 feet. The guns of the foremost turrets are about 31 feet above the water, turret No. 2 about 28 feet, turret No. 3 about 29 feet, and turrets Nos. 4 and 5 about 28 feet above the water. When the "Utah" goes into commission she will be in command of Capt. W. S. Benson.



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Displacement, with two-thirds stores and fuel and full ammunition supplies, is 21,825 tons. **Speed,** 21.8 knots. **Coal,** 2,500 tons. **Oil,** 400 tons. **Armor:** Main belt, 11 to 9 inches; upper belt, 10 to 8 inches; barbettes, 11 inches; turrets 12 to 8 inches. **Guns:** Ten 50-caliber 12-inch; sixteen 50-caliber 5-inch. **Torpedo tubes,** two 21 inch. **Complement,** 984.

OUR LATEST BATTLESHIP—THE "UTAH" STEAMING 21.8 MILES ON HER SPEED TRIALS

Pigments from Odd Sources

THE ingenuity of the manufacturers of pigments for the use of artists has been so severely taxed within recent years that they have been obliged to employ for the purpose all manner of animal, vegetable and mineral substances. Even Egyptian mummies have been utilized in this way by the manufacturers.

It appears that the corpse of the old Egyptian was preserved in the finest bitumen, and that the remains thus treated in the centuries gone present, on being unwrapped to-day, an appearance quite like that of light-colored leather. Now it has been discovered that, when the bitumen and the leather-like remains are ground down by machinery, there is obtained therefrom a beautiful brown pigment, especially prized by painters of portraits, who claim that this pigment is particularly effective in depicting certain shades of brown hair.

Among the other colors obtained from strange sources may be mentioned Prussian blue. This is made by fusing the hoofs of horses with impure potassium carbonate.

Sepia is the dark fluid discharged by the cuttlefish to render the water opaque for its own concealment when attacked by its enemies.

The cochineal insect furnishes crimson and purple lake and carmine, while ultramarine is procured from the precious metal known as lapis lazuli.

Raw sienna is natural earth from Sienna, and, when burnt, becomes burnt Sienna. Gamboge is the yellow sap of a tree that grows in Siam.

A Sun-dial as an Accurate Time-piece

A Spot of Light That Tells the Time of Day

IN these days of accurate clocks and watches no one thinks of using a sun dial to tell the time of day. At best such an instrument can be right but four times a year, and in many places it can never agree with standard time. Yet the demand for sun dials was probably never greater than it is now, merely because, as an ornament, it adds a quaint and picturesque touch to the lawn or garden, or else it harmonizes well with the architectural treatment of a building. As standard time is obtained primarily from the sun, with due allowances for its variations from noon to noon, there is no reason why a sun dial should not give us accurate time if we make similar allowances.

A novel sun dial in which such regulation can be made is illustrated on this page. This dial differs radically from the common type. Instead of showing the time of day by a shadow cast by the sun, it employs a spot of direct sunlight which is brought to bear upon a hair line on a white screen. The dial of the instrument is tilted according to the latitude, so that it will lie parallel to the plane of the celestial equator. The photograph shows the instrument set for the latitude of New York. The base must be oriented accurately, and the dial face tipped to the latitude of New York (which is about 41 degrees), the upper angle being found by means of the graduated sector on which the dial face is supported. The dial proper is divided into equal divisions to indicate the hours of the day, and opposite the 6 A. M. and P. M. marks are two upright brackets, one of which serves as a screen (at the left in the illustration), while the other contains the perforations through which the sun shines, making a spot of light that falls on the screen. As the face of the dial is parallel with the celestial equator, its edge forms an artificial horizon, along which the sun apparently travels. Because the sun mounts above the celestial equator in summer time, and falls below it in winter, two holes are formed in the bracket at the right, one above the other, so that the spot of light will be sure to strike the screen through one or the other of these holes at any time of the year. In order to allow for variations of the sun, the bracket containing the two apertures is made adjustable in the following manner. On the face of the dial will be noticed a smaller dial marked with the months of the year, while adjacent to it is a scale divided into thirty-one equal parts representing the days of the month. If the reading is to be taken on, say, February 6th (as shown in the photograph), this small months' dial must be moved to bring the February mark in line with the sixth mark on the scale. An elliptical cam is connected to the months dial, and engages an arm to which the bracket is connected, thereby shifting the bracket laterally, according to the position of the dial. In February, the sun time is nearly a quarter of an hour slow, consequently the bracket is moved upward or eastward a corresponding amount. This done, the main dial is turned until the spot of light passing through the lower aperture is bisected by the hair line of the screen. The reading of the time is then taken upon a small scale shown at the right in the engraving. This is divided to indicate minutes, and in our illustration the time is shown to be 4.20. When the instrument is first set up the minutes scale must be adjusted so as to harmonize mean local time with standard time. As the sun passes over New York (on the 74th meridian) four minutes before it reaches the 75th meridian, on which New York standard time is based, the minutes scale must be set to read four minutes slow in order that the time as shown by the dial will agree with standard time.



SUN-DIAL THAT GIVES CORRECT STANDARD TIME

We who live in regions where there are plenty of clocks and timepieces of precision hardly realize the practical value of such a dial. In sparsely settled localities, for instance, on remote plantations, an instrument that will give correct time to the minute, obtaining this time directly from the sun, should be almost indispensable.

Casting Cement Building Walls on the Ground

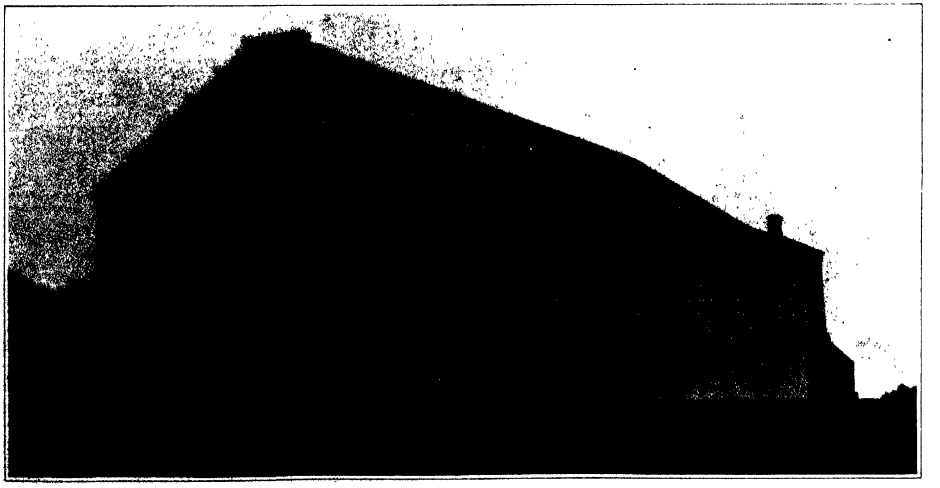
A Church Built in a Novel Way

THE accompanying illustrations show a method of a new system of reinforced concrete building construction, in which the church walls are erected by means of raising jacks.

On the foundation wall and on piles inside of the building lot are set a series of jacks made of steel. These jacks consist of a supporting carriage, a pivoted walking beam, and a collapsible screw driven by a worm gear and worm. A platform is laid on the jacks and on this platform are set in their proper relative positions, all door-frames, window frames and other openings. The concrete is poured around the opening thus established. The reinforcement is easily and properly placed horizontally and vertically, because the wall resembles a great draughting board and is very readily "laid out." The entire wall is poured at once, which can be done in a single day, even though the wall be 200 feet long and three stories high. After the wall is finished it is allowed to set for forty-eight hours, then a small gasoline engine or electric motor is connected with the driving shaft, and the wall rises from the inside slowly and quietly to its permanent vertical position.

When all the walls are in place the corners where reinforcements from either wall project and interlock are poured and we have a complete monolithic, well finished structure. Floors and roof of concrete or of any construction desired are put in place in the same way as in any other building.

No forms are used whatsoever in this wall construc-



THIS STRUCTURE WAS BUILT IN SECTIONS FLAT ON THE GROUND

tion except the wooden jack platform, which is never destroyed, but is used over and over again An air space can be made merely by filling in with loose sand which is rodded out when the concrete sets and the wall is partially raised The reinforcement is placed both horizontally and vertically exactly where it belongs in both inner and outer wall It is possible to use rods, fabric or any other kind of reinforcement without the slightest difficulty

An Airman's Weather Bureau

DO YOU remember how, in Kipling's "With the Night Mail," the Mark Boat flashes news of the wind and weather along the several "levels" so that the aerial liners may take advantage of favorable currents, and avoid the besetting dangers of the sky so graphically described in the same prophetic tale? It was only yesterday that Kipling dreamed his dream—of "the year 2000"—and to-day we stand upon the threshold of its realization

Not to dogmatize about the future and assert that the airman will always be more at the mercy of the elements than the seaman, and that consequently the cultivation of aerial meteorology will be more urgently imposed upon our posterity than that of maritime meteorology is upon our contemporaries, we are safe at least in declaring that in the year 1911 such is decidedly the case The sea has been robbed of nearly all its terrors Even *mal de mer* is an anachronism and a solecism on a "Mauretania" or "Olympic" The dangers of the air are not yet even half appreciated

To the meteorologist, already burdened with the heavy responsibilities imposed upon him by the mariner and the farmer, the producer and the transporter of perishable goods, the seeker of health and the seeker of pleasure, has suddenly been assigned the twofold task of charting the aerial ocean and giving the aeronaut timely warning of its dangers

That meteorology is even now ready to enter upon its new duties is the confident belief of Dr Richard Assmann, director of the Royal Prussian Aeronautical Observatory of Lindenberg

The noble institution over which Dr Assmann presides—situated some forty miles southeast of Berlin—was fully described in the SCIENTIFIC AMERICAN SUPPLEMENT of July 13th, 1907 It has been, ever since it was founded, the heart and brains of "aerology" in Germany, its contributions to meteorology have been almost epochal, but its enormous practical significance to aeronautics has only recently begun to be realized

In a long article on "The Dangers of Aerial Navigation and the Means of Diminishing Them," contributed to the *Deutsche Zeitschrift fur Luftschiffahrt*, Dr Assmann a few months ago described, among other things, the aeronautical weather service that he was then organizing, and which with Lindenberg Observatory as its center, is now in full operation Dr Assmann's account of his new undertaking is summarized in the following paragraphs

It should be stated at the outset that at least three tentative schemes of this sort had previously been put into execution in Germany, though on a relatively small scale The first was undertaken by Lindenberg Observatory in 1907 on the occasion of the trial trips of the "Parseval," observations of the upper air-currents were made simultaneously at five stations by means of pilot-balloons and communicated to the crew of the airship, who were thus materially aided in shaping their course The second similar undertaking was Dr Linke's special weather service for aeronauts in connection with the aeronautical exposition at Frankfort—the "Ila" (I L A, Internationale Luftschiffahrts Ausstellung)—a notice of which appeared in the SCIENTIFIC AMERICAN of June 18th, 1910, pp 511-512 The third aeronautical weather service was organized by Dr Polis, at Aachen, and is still in operation. It is intended especially for the benefit of the many aero clubs of the Rhineland, but its utility was conspicuously demonstrated during last year's army maneuvers in West Prussia

These local and quasi-experimental undertakings have paved the way for a national aeronautical weather bureau For the moment its field of operation is northern and central Germany—i e, Prussia and the states that are especially under Prussian influence—but its extension to the remaining German States will follow as soon as the wheels of diplomatic machinery have performed the requisite number of revolutions Political heterogeneity still hampers imperial undertakings in Germany to a degree that Americans find it difficult to realize

If we examine the facilities available for the proposed extension of the domain of practical meteorology to the upper air, we find that Germany is much better prepared for such an undertaking than the other European states Four years ago the Prussian Government decided to infuse new life into its weather service, especially with a view to the requirements of agriculture. The Ministry of Agriculture, Domains and Forests established in Prussia and the neighboring states, independently of the previously existing meteorological institutes, a network of seventeen forecasting and map-publishing weather stations, modeled, in a large measure, after those of the United States Weather Bureau Dr. Börnstein, of Berlin was a leading spirit in this undertaking, and Dr. Polis, of Aachen, spent two months in the United States, inspecting the methods and *matériel* of the American weather stations Germany's new Public Weather Service is now in vigorous operation, and represents an intensive application of the methods of applied meteorology that is hardly paralleled elsewhere outside of the United States

In the summer of 1909 the writer of this summary paid a visit to Dr Hergesell, president of the International Commission for Scientific Aeronautics, at Strasburg This distinguished aerologist was even then urging the equipment of the Public Weather Service stations with pilot-balloons, in order that daily observations of upper-air currents might be secured at many points throughout the empire for the information of forecasters. It is, however, significant of the mode in which scientific ideas unfold themselves, step by step, that in the course of a half-hour's conversation on this subject Dr Hergesell never once suggested the advantages that the adoption of his project would offer to aeronauts—notwithstanding the fact that he is an aeronaut himself and had at that time made several voyages with Zeppelin So far as the writer can recall, his point of view was entirely meteorological, the forecasts that he hoped to improve were those applying to land and sea, and certainly the same may be said of his writing at that period, as well as those of Querpain, Schreiber, Kremser and the other enthusiastic advocates of the pilot balloon.

The hopes of Hergesell are now being realized, but the point of view has shifted Lindenberg Observatory has now equipped the Public Weather Service stations with the apparatus needed for daily observations of the upper air, not primarily for the purpose of improving the regular weather forecasts, but in order to secure the means of lessening the dangers of aerial navigation—dangers, in Assmann's opinion, largely avoidable, which cost twenty valuable lives in Germany during the year 1910 alone To-day the aeronaut launches his craft with no more knowledge of the meteorological conditions in the upper air than can be vaguely surmised from those depicted in the ground-surface weather map. To morrow he will have a weather map all his own, representing, as a rule, quite a different set of conditions from those prevailing at the lower level

The details of the plan by which this desideratum is being accomplished can best be stated in its originator's own words We quote from his memoir, referred to above, which was written a few weeks before the new service began its work.

"A number of the Public Weather Service stations, or better, if the cost does not prove too great, all of these stations in northern and central Germany, are to be furnished by the Lindenberg Observatory with a theodolite, an inflating-balance for determining the ascensional force of the balloons, a sufficient number of rubber balloons, and the necessary graphic tables for rapidly working up the observations Where it is not practicable to provide compressed hydrogen gas in steel tanks, a Naas-Gradenwitz gas-generator will be supplied

"The stations will be expected to send up a pilot-balloon at 8 A M on every day when the weather and state of the sky are favorable, and to follow its course with the theodolite as long as possible. The observation will then be worked up—a matter of barely a quarter of an hour for a practised observer—and telegraphed in cipher to Lindenberg Here the observations received from all the stations will be assembled, and redistributed, in a single telegram, to each of the co-operating stations, where, if they arrive in time, they can be utilized in connection with the ordinary daily weather forecast, as well as in preparing special forecasts and warnings for aeronauts At Lindenberg the regular observation with a kite or captive balloon is made daily at 8 A. M., and in summer an observation is also made about 5 or 6 A M These furnish not only data concerning the wind such as are obtainable with a pilot-balloon, but also data of the other meteorological elements It is also proposed to make a daily observation at Lindenberg with a pilot-balloon at 11 A. M., and whenever circumstances require another about 2 P M., so that soundings of the air up to an altitude of several thousand meters will be made three or four times daily within a period of from six to nine hours, affording valuable information as to rapid changes in the upper atmosphere. It is hoped that it may be found practicable also to make a midday observation at some of the other stations, especially at the kite-station of the Deutsche Seewarte, at Hamburg, which is already well equipped for such work.

"It is altogether likely that the Public Weather Service stations will be supplemented with stations especially erected for the purpose at the larger aviation fields, airship sheds, and the like. One of these has already been assured at Bitterfeld. Another important addition to the aerological *réseau* will be the 'Aeronautical Observatory on the Inselberg,' near Gotha, the erection of which has been intrusted to the authorities of Lindenberg Observatory by the Duke of Saxe-Coburg-Gotha, and which will be installed next spring. There is also a prospect that the long-promised aerological station on the Taunus will soon be erected, and will contribute its part to the new service. Lastly, aerological stations will probably be installed at certain nautical schools on the coast, thus providing observations from a region that is particularly dangerous to the aeronaut

"While pilot-balloons afford the easiest and cheapest method of exploring the upper air, they labor under the serious disadvantage that they cannot be used in foggy weather, or even when the clouds hang very low. During the winter months, especially, one cannot count upon obtaining observations by this method up to one or two thousand meters more than about half the time. This of course applies especially to an early morning observation, at a fixed hour, toward midday there is a better prospect of clear sky, especially if one is on the alert to take advantage of occasional breaks in the clouds. As a measure of economy, the stations will be supplied with balloons of two sizes; the smaller and cheaper to be used when it is evident that the state of the sky will not permit the balloon to be followed with the theodolite to a great distance. In special cases it may be possible to make observations at night by the use of the illuminated balloons manufactured by Saul of Aachen, this method, however, is relatively expensive.

"There will, however, undoubtedly be many days on which few if any observations can be secured with pilot-balloons, and observations will be available only from stations equipped with captive balloons and kites In order to meet this serious difficulty, the Lindenberg Observatory is considering the plan of supplying a few selected stations with a simple and easily manageable kite-outfit."

This plan leaves to be considered only the relatively infrequent case of cloudy or foggy weather combined with a calm air, in which a kite could not be raised The obvious way out of this difficulty, if the expense did not forbid, would be to further equip the stations with captive balloons, carrying self-registering apparatus However, Dr. Assmann admits that such an expedient must be relegated to "a happier future"

The plan outlined above was approved by the German Government and, in its main features, went into operation January 2nd, 1911 Funds have subsequently been granted that insure the continuation of the enterprise at least until April, 1912 The service is being used to the fullest extent by the many aeronautical societies of Germany, and is adapting itself to practical requirements in various ways not contemplated in the original programme Thus it is interesting to notice that special arrangements were made for supplying meteorological information to the participants in the great "Rundflug" of June 11th to July 7th; two officials of the service were detailed to accompany the fliers, and to make frequent observations of the upper air-currents, with pilot-balloons, at the beginning of each stage of the course, and all stations were expected to make and telegraph aerological observations three times a day during the period in question

It is hoped that the field of observation will soon include the South German States; especially as this would bring to the enterprise the valuable co-operation of the so-called "kite-station" at Friedrichshafen, on Lake Constance, which is really a "balloon-station," as the wind over the lake is rarely strong enough to raise a kite, even though aided by the motion of the small steamboat from which the apparatus is flown, and much the larger part of the daily observations are made with captive balloons. One of Dr. Assmann's cherished plans is the erection of a similar "floating kite-station" on Danzig Bay, as an appendage to the Lindenberg Observatory.

The founder of the aeronautical weather service realizes that his plan is open to the objection applying to weather services generally; viz., it cannot hope to provide detailed information and forecasts of local conditions except in so far as these may be inferred from the general outlook. To revert to Kipling, one of the gravest situations in which the aeronaut may be placed arises "when the Heavens are balancing their valt-accounts;" and to forecast the occurrence and movement of a thunderstorm from the observations of a few widely separated stations is a well-nigh hopeless undertaking. Is it feasible to secure a corps of

special thunderstorm observers reporting by telegraph and telephone large enough to enable the forecaster to follow the progress of these disturbances across the country and give timely warning to the aeronaut to get out of their path—possibly using wireless telegraphy for transmitting the warnings? Dr. Assmann thinks so and has even made a detailed estimate of the probable expense. However, this is not part of the programme definitely formulated for Germany's "airman's weather bureau."

SPECIAL WEATHER SERVICES FOR AERONAUTS.

In Germany it has become the regular practice to organize a special meteorological service in connection with every important aeronautical competition. Some of these special services, as well as the permanent general service recently organized by Assmann, have already been described in the SCIENTIFIC AMERICAN. The most important undertaking prior to Assmann's was that of Dr Franz Linke in connection with the Frankfurt aeronautical exposition of 1909.

The *Deutsche Zeitschrift fur Luftschiffahrt* describes the weather service recently operated in connection with the German reliability flight in the upper Rhine district. A meteorologist traveled over the route with the contestants, making observations and issuing forecasts at each stopping-place. Three principal lines of work were carried out, viz. (1) The telegraphic weather reports of the Deutsche Seewarte were received and twice-daily forecasts were issued of the weather along the route (2) Each day, before the flying was resumed, the movement of the upper air was observed locally by means of pilot-balloons, the general behavior of the upper currents over Germany was determined from telegraphic reports of similar observations made at the fifteen regular pilot-balloon stations operating under the Lindenberg observatory, and the wind at the surface was measured with a portable anemometer (3) A special thunderstorm service was in operation Sixty observers, distributed over southwestern Germany, sent in an "urgent" telegraphic report whenever thunderstorms approached their respective localities This service proved to be especially efficient and useful; several thunderstorms occurred and the aeronauts were warned, at least an hour in advance, of the arrival of each of them

Freezing Experiments on Fish and Other Animals

SOME remarkable experiments were made not long since at the University of Geneva by M Raoul Pictet, whose name is intimately connected with the production of artificial cold He was, in fact, one of the pioneers in this field, which has now taken so wide a development In the course of some recent work he was able to take live fish, such as goldfish and many of the fresh water varieties with which we are familiar, and place them in a tank Then he freezes the water in which the fish are swimming, so as to form a block of ice Then he freezes the ice block still further, down to a low temperature, about 20 deg C. below freezing point, and keeps the whole at this point by means of a freezing apparatus for two or three months After this time the block of ice is thawed out very slowly, and the seemingly dead fish come to life and swim about as usual

This is the simple but most remarkable experiment which M. Pictet realizes, adding a new discovery to the important ones he has already made However, these latter relate mainly to industrial processes, while the present experiment is one of far-reaching interest to science in general. In a recent interview with the *Matin*, of Paris, M Pictet states that his first experiments upon life at very intense cold date nearly eighteen years back He became convinced that if the chemical reactions of a living organism could be suspended without causing any organic lesion, the phenomena of life would disappear, but these would come back as soon as the organism was restored to the usual conditions. Great cold will suspend the operations of life as far as we are able to observe, but without losing it totally. He made some very conclusive experiments upon fish, as we already noted, and these could be completely frozen and then thawed out without causing loss of life On one occasion, while working on this subject at the university, he put twenty-eight fish in a deep glass basin, and left them for twenty-four hours in water at about the freezing point. Then he froze the water to a solid block, together with the fish, going down to 20 degrees By breaking off part of the block, one of the fish could be taken out, and he found that it could be broken in small pieces just as if it were made of ice itself After thawing out the block, it is found that no harm has been done the fish, and they swim about just as if nothing had happened.

The freezing must not be carried down too far in the case of fresh water fish, and the temperature indicated above is about the lowest which can be used, otherwise the fish will be killed However, there are other animals which can stand a much greater amount of cold. Frogs come next in order to fish in this respect, and can be frozen down to 28 deg C below the freezing point Some water lizards or salamanders will stand more cold, or 50 degrees. He finds that snails will resist the greatest amount of cold among the specimens which he tried, and they can be frozen as low as 120 deg C below the freezing point, and will then come back to animation

Correspondence

The Invention of Artificial Rain Apparatus

To the Editor of the SCIENTIFIC AMERICAN

In your issue of April 15th, 1911, there appears an article on the production of artificial rain for agricultural purposes, in which article certain rain producing apparatus is described, the invention of which is credited to a German whose name is given as Hartmann

Permit me to call attention to the fact that the system of rain producing described in your article, which I notice is credited to the German periodical *Prometheus*, is my invention, and that I have secured the following patents on it

	Patents No
British	9,004
Australia	15,376
United States	958,937, 963,932
France	403,701
Belgium	211,923
Argentine Republic, 5,684, 6,392, 6,642, 7,170, 7,171, 7,944, 7,949,	8,292
Brazil	5,651
Chile	2,215
Uruguay	412, 474

Including four German claims now pending in the Imperial Patent Office in Berlin

I write this letter in order that any wrong impression that may have been created by the article from *Prometheus* may be removed

New York city EMILIO OLSSON

The Difference Between Light and Heavy Winds

To the Editor o the SCIENTIFIC AMERICAN

In the issue of May 20th, page 507, of the SCIENTIFIC AMERICAN, under heading, "Home-made Anemometer," the formula to obtain true velocity of wind is

$$P = 0.400 - S\,V^2. \quad \frac{B}{30}$$

Shouldn't this read $P = 0.004 - S\,V^2$? $\frac{B}{30}$

Would you please inform me just where you draw the line between light winds and heavy winds?

Pittsfield, Mass P. N. MOORE.

[Our correspondent has very properly called attention to an unfortunate typographical error in the article referred to The factor 0.400 was a misprint for 0.004

We may add that the factor $\frac{B}{30}$ (correction for barometric pressure) can safely be neglected when the place of observation is near sea level

The choice between the larger and the smaller windplates must be decided by the observer's experience in the use of the instrument. It will depend, of course, upon the strength of the spring and the length of the scale, as well as upon the force of the wind.

The whole subject of normal pressure-plate anemometers, and the various forms of such apparatus (the earliest of which dates back to the year 1724) will be found fully discussed in C. Abbe's "Treatise on Meteorological Apparatus and Methods," which was published as an appendix to the Annual Report of the Chief Signal Officer for 1887

It is hardly necessary to state that the rough-and-ready instrument described by Mr. Gilbert should, whenever possible, be compared with a standard anemometer—or, more conveniently, a Richard anemocinemograph, which shows the velocity of the wind directly, at a given moment—and its error thus determined.

Having obtained a fairly accurate instrument, it should be further borne in mind that the velocity of the wind near the earth's surface is nearly always very much less than that prevailing at the altitude of an ordinary aeroplane flight; and that the existing statistics of the variation of winds with altitude are mere averages, subject to wide fluctuation. On the whole, the anemometer is, as yet, of but moderate utility in aeronautics.—ED.]

Self-luminous Night Haze

UNDER the above title Prof E E Barnard, of the Yerkes Observatory, publishes in the *Proceedings of the American Philosophical Society* an important contribution to the subject of nocturnal sky-light His paper is especially interesting for the reason that, at the time of writing, the author appears to have been unacquainted with the publications of Yntema, Maurer, and other Europeans on the so-called "earth-light," a brief account of which was published in the SCIENTIFIC AMERICAN Nov 19th, 1910, p 394 Barnard's observations confirm and supplement those of his European confréres

On moonless nights the sky is often more or less distinctly luminous, and this luminosity cannot be wholly attributed to the diffusion of the general starlight by moisture in the air At times the illumination is so great that the face of an ordinary watch can be read by it There seems to be no doubt that this luminosity is of an auroral nature, as it has been shown that the spectrum of the aurora is essentially always present on a clear dark night In describing this phenomenon the author merely corroborates the observations of several earlier writers, but he proceeds to describe a particular manifestation of this luminosity - or possibly a phenomenon distinct therefrom—to which attention does not appear to have been previously directed

This consists of strips and patches of luminous haze, which have been observed at Yerkes Observatory several times during the past year It is not confined to any particular region of the sky nor to any hour of the night It always has a slow drifting motion among the stars, comparable to that of ordinary hazy streaky clouds that are often seen in the daytime The streaks are usually straight and diffused, and as much as 50 degrees or more in length, and 3 degrees to 4 degrees or more in width In some cases they are as bright, or nearly so, as the average portions of the Milky Way, i e, they are decidedly noticeable when one's attention is called to them They are apparently about as transparent as ordinary haze Sometimes, when seen near the horizon, where they may be rather broad, they have strongly suggested the "dawn" or glow that precedes a bright moonrise Their luminosity is uniformly steady

The writer believes this haze to be something quite different from the noctilucent clouds that were seen for several years following the eruption of Krakatoa, but only during the short nights of summer, whereas the haze has been seen through last autumn and winter The noctilucent clouds, with which Jesse's name is always associated on account of his indefatigable study of them were pretty conclusively shown to consist of fine volcanic dust, floating at so great an altitude (upwards of 50 miles) as to receive and reflect the light of the sun long before and after the ordinary clouds Prof Barnard believes what he has seen to be ordinary haze, in some manner rendered self luminous In one instance he watched strips of this luminous substance from before dawn until, as the daylight killed their luminosity, they were seen to be strips of ordinary haze

Meteorologists who read Prof Barnard's paper will undoubtedly be reminded of the references that are occasionally made by students of clouds to "auroral cirrus," for although the author throughout his paper speaks of "haze," he is evidently referring to cirrus or cirrostratus clouds—which are quite distinct from haze in the usual meteorological sense Cirrus seen in the daytime often simulates the forms of the aurora, and that there may be some connection between the two phenomena has often been suggested

A Lake with a Roof

THE great salt lake at Obdorsk is nine miles wide and seventeen miles long, yet except in a few places it is solidly roofed over with a deposit of salt which is becoming thicker and thicker each year

About the middle of the last century salt crystals first began to gather upon the surface of the water Year by year, owing to the evaporation of the water, the crystals became more numerous, and then caked together until this great roof was formed In 1878 the water beneath this salt crystal roof found an underground outlet into the Obi River This covered the lake's surface about three feet leaving that distance between the water and the roof, and each year this distance has been diminished by the constant addition of salt crystals to the roof

Many springs surround this lake Their water flows over the roof and evaporates there and thus continually adds to its thickness After many years the springs will probably become choked with their own deposits, and then the whole will become covered with earth, so that a great salt mine will be formed—a treasure for the Siberians hundreds of years to come

Abstracts from Current Periodicals

Phases of Science as Other Editors See Them

Studying the Anarchists' Bomb Scientifically

THE bomb laboratory described below is not a place in which bombs are made. No layman has yet penetrated into the secrets of the manufacture of bombs for military use, so that there is nothing to be said on that subject. More is known of bomb factories of another sort, which are operated by criminals, but it is not advisable to describe these establishments, lest the description fall into the hands of some person who might be tempted, either by malice or by simple curiosity, to engage in the manufacture of bombs. The bomb laboratory, the description of which is here quoted from *Reclams Universum*, is operated by the police of Paris for the purpose of investigating and destroying bombs found in the city. It has served as the prototype of similar establishments in other cities.

The progress of chemistry continually makes the path of the transgressor more hard. The slightest trace, even a drop of blood no larger than a pin's head, may suffice to convict a murderer. The impression made on a cartridge by the hammer of a pistol, or a single hair found on the clothing of the suspected person, may serve as valid proof of crime. Until recently, however, science has been almost powerless against the pernicious activity of the bomb-thrower. When a bomb explodes, it is shattered into thousands of minute fragments, and its contents are resolved into gases which cannot be caught and investigated. The effectiveness of bombs depends upon the fact



A bomb with a three-hour fuse.

that they are filled with substances which, when ignited, evolve enormous quantities of gas in a minute fraction of a second. The explosive force of this suddenly evolved mass of gas is enormously increased by the very high temperature to which it is heated by the accompanying chemical reaction. Hence, a bomb which can be carried in the pocket is able to produce terrible devastation.

Nevertheless, the bomb thrower is sadly deceived if he believes that an exploded bomb leaves no trace because its whole contents are converted into gases and because the shell is made of an old gas pipe or tin can, fragments of which would convey no special information leading to the identification of the criminal. It was difficult indeed for chemists to devise methods of discovering the secrets of shattered bombs, but even this difficulty has now been surmounted. This is proved by the recent trial of one of the criminals who attempted to blow up the Municipal Building in Friedberg in order to rob an adjacent bank in the resulting confusion. These same criminals had previously attempted to extort money by threatening letters from a wealthy banker in Frankfurt, and, in order to intimidate him, had placed a bomb in front of his residence. Although the bomb exploded according to the design of the criminals, it nevertheless was the cause of their undoing. The walls of the house were examined very thoroughly, and a few small fragments of the contents of the bomb, which had been thrown out before the flame reached them, were found. These few particles of the explosive mixture, in connection with some other evidence, sufficed to prove with certainty that the bomb had been filled with blasting gelatine. Here was one point gained, and a second resulted from the careful examination of the fragments. Blasting gelatine is made by a great many factories, which differ in their processes and in the composition of their products. It was proved with certainty that the blasting gelatine found in the wall had been made in a factory at Saint Ingbert, from which it had recently been stolen. This was sufficient to identify the criminal completely, because only one person could have been guilty of the theft. In a similar manner the composition of the bomb which exploded in 1907 before the police station in Offenbach



The Paris bomb laboratory.

was determined from a few fragments. In this case a lead tube had been filled with a rather common explosive mixture, but it was found possible to discover not only the character of the mixture, but also the mechanical construction of the bomb.

Very much more dangerous than burst bombs are those which for any reason have failed to explode. Here it is not only necessary to examine the bombs in order to identify the criminal, but it is first of all requisite to make them harmless. This is a rather difficult matter. Some bombs are so constructed that they explode instantly upon the slightest shock or as soon as an attempt is made to disturb their position. The most important of these bombs are those in which the explosion is brought about by means of a liquid contained in a glass tube. The bomb is usually so contrived that the slightest displacement causes a weight to fall upon the tube and break it, so that the liquid escapes and comes in contact with substances which, under its action, explode with great violence. These bombs are perhaps the most dangerous of all, and the methods which are commonly assumed to be proper for the destruction of bombs—immersion in water, for example—are powerless against bombs of this character, which explode in water as well as in air.

Bombs which are exploded by fuse are much less unpleasant to handle, both for the policemen and the bomb throwers, who in many cases have been killed by the premature explosion of bombs of the other type. Usually, however, the glass tube containing the exciting liquid is lowered carefully into the bomb after the latter has been placed in position.

The fuse employed for the ignition of a bomb is usually very long, so that the criminal has plenty of time to escape, and even to accomplish a railway journey of several hours before the bomb explodes. The fuse consists usually of a rain of sulphur or a cord saturated with sulphur. From the time which a measured portion of this cord occupies in burning, the length of fuse required for any desired interval between ignition and explosion can be calculated with accuracy. The bomb shown in the illustration, which



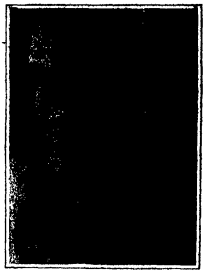
Automobile with a safety bomb carrier.

was found in Paris on a window sill, was provided with a fuse which would have occupied three hours in burning. It would be a great mistake, however, to simply quench or tear out a burning fuse and then freely handle the bomb, for many dynamiters are ingenious enough to attach fuses to the more dangerous bombs of the liquid type in order to mislead the finder in this very way. All bombs, therefore, whether provided with fuses or not should be handled and examined in the careful manner described below.

In the first place, the bomb must be removed safely from the city to the laboratory in the suburbs. For this purpose it is seized with very long tongs of peculiar construction, and slowly and carefully removed, without changing its position with respect to the horizon, from the house or other place in which it is found, to an automobile provided with a safety bomb carrier, which is simply a box supported on gimbals like a compass. Such an arrangement is called a Cardan suspension, from the name of the Italian physicist, Cardono, its alleged inventor. In reality, however, the device was invented by Leonardo da Vinci, as has recently been demonstrated by Dr. Otto Werner. The Cardan or gimbal suspension is used in all cases where it is necessary to keep a body perfectly horizontal. It consists of two concentric rings which can turn on axes lying in the planes of the rings and at right angles to each other. The body to be kept level is attached to the inner ring.

When the bomb has been safely placed in the carrier the most difficult part of the work has been accomplished. The automobile then proceeds very slowly and cautiously to the bomb laboratory, and any small shocks which it experiences are prevented from affecting the bomb by the Cardan suspension.

The bomb laboratory of Paris is situated in the suburb of Vincennes. The bombs are destroyed in a shed constructed of light boards and surrounded by



Hydraulic press for crushing bombs.

a wall of earth and an outer and high wall of masonry. If a bomb explodes, the surrounding country, which is a waste and uninhabited land, is thus protected from injury. This precaution is not unnecessary, for stones have been thrown more than a mile by the explosion of a bomb. If the Paris laboratory should be destroyed by a bomb, the light boards would be shattered into still lighter fragments, whose flight would soon be stopped by the resistance of the air. For additional precaution, the building is open at the upper part immediately under the roof, so that the pressure of the exploding gases cannot become very great. The shed is also surrounded by a board fence, at one corner of which stands a sentry box which is always manned. Inside of the fence and outside of the earth wall is situated a workroom containing a collection of bombs and fragments of bombs, with apparatus for the examination of bombs. Here, also, is the pump cylinder of a hydraulic press which is connected by a subterranean tube with the press cylinder in the bomb shed, inside the earth wall. The bomb is removed from the automobile with the greatest care and placed upon the piston of the press and below the fixed headpiece. The men then retire to the outer workroom and the press is set into operation. As the piston rises the bomb is crushed. It has been proved by experience that the safest method of opening bombs is by crushing in this manner because all parts of the bomb are left undisturbed, and because the shell is usually cracked before the glass tube is broken. If an explosion occurs the gases can escape through the broken shell without doing much damage, as they encounter little resistance at this point or in the open shed, so that the contents of the bomb are quietly consumed, leaving sufficient traces for the determination of the composition of the mixture.

It is evident from this description that the struggle between the chemist and the dynamiter is not without interest, and that it is waged with modern weapons in

the full sense of the word, despite the employment of the rather crude, mechanical aids which have been described. It is especially gratifying to find that in this difficult field the criminal has been conquered by science.

A Flexible Steering Column for Automobiles

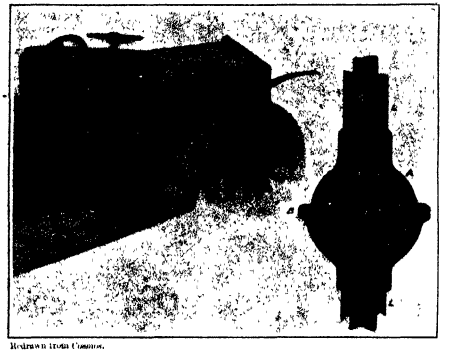
WITH the low and elongated automobile bodies that have recently come into favor the steering column is necessarily placed in a very oblique position. This construction is both inconvenient and dangerous, for when the driver has insinuated himself into the narrow space between the steering column and the seat he is completely imprisoned and immobilized by these parts, by the levers at his right and by the passenger at his left, whom he must disturb in order to leave his seat. If the car is suddenly stopped by a collision, the driver is projected violently forward and is seriously injured by the steering wheel

A French inventor named Martinot has patented a steering column which can be bent forward sufficiently to permit the driver to mount and dismount easily, even on the right side, and which bends forward automatically in case of sudden stoppage, so that the driver is thrown clear of the car, instead of being crushed by the steering wheel. The description and illustrations of the apparatus which are here given are taken from a recent issue of *Cosmos*.

The steering column is made in two parts, *MM*, which are connected by a universal joint *I* (Fig. 1), of simple and massive construction, which does not impair the strength of the column. The movement of the upper part of the column is confined to a fore-and-aft vertical plane by two hemispheres *AA'*, which are attached respectively to the tubes *L* and L_1 inclosing the fixed and movable parts of the column, and which together form a hinge joint, turning on the axis at *B'*. The fixed and movable parts of the column are securely fastened to the cross of the universal joint by pins, in addition to the screw-bolts *GF*, etc.

The two extreme positions of the steering column are shown in **Fig. 2**. The angle of displacement is limited by a stop, which is adjusted in accordance with the space available in each vehicle. The movable part, in consequence of its weight, naturally assumes the normal position, in line with the fixed part, and the pressure exerted on the wheel by the driver's hands, tends to hold it firmly in this position. The inventor claims that the wheel cannot be thrown forward by vibrations of the car or inequalities of the road, even at the highest speed.

As the two parts of the column, however, are connected by a universal joint, the apparatus works perfectly in any position. It may, therefore, be modified by the addition of a second stop so that the two parts of the column are never in line, but form with each other, even in steering, an angle determined by the convenience and preference of the driver.



Redrawn from Cosmos.

FLEXIBLE STEERING COLUMN FOR AUTOMOBILES

Why Europe Is in Advance of America in Pioneer Inventions

THE discussion which was recently started in the columns of *Engineering News* on the subject of Europe's superiority in the matter of pioneer inventions has called forth, among other letters to the editor of that journal, one from Mr. George H Gibson, which should be illuminating and highly instructive to readers of the SCIENTIFIC AMERICAN.

Mr. Gibson says, very truthfully to our mind, that "while most American manufacturers are aware that the profits of engineering lie in pioneer work, not all of them as yet understand the proper utilization and management of research. The demand for research is not brisk over here and the schools have done little either to excite it or to turn out men properly qualified to fill the demand if such should arise. Possibly as an incident of rapid commercial expansion, engineering enterprises are generally controlled by business men, rather than by directing engineers, while the technician is a subordinate employee, who receives little encouragement or aid toward the initiation, planning or carrying out of sustained investigations."

In Europe, Mr. Gibson assures us, the situation is different. "The engineer or scientist frequently occupies a more independent position. I am told, for example, that Prof. Rateau, who has developed many lines of centrifugal machinery, including steam turbines, centrifugal pumps, air compressors, blowers, etc., becomes various concerns in France, Germany and elsewhere, that is, his rights are not assigned *in toto* to some corporation, as would probably happen in America.

"Similarly the professors in the leading German technical schools, in addition to teaching, maintain large engineering offices, in which research and experimental development work is prosecuted on an extensive scale. The remuneration received from their inventions and for their engineering work enables these scientific engineers to maintain large staffs, while their connection with the laboratories and the other facilities of educational institutions naturally leads to the full utilisation of the resources of scientific knowledge and methods"

Pure Food and What It Means

IF so much of our lives and so much of man's ambition are bound up in the great problem "What to Eat and How to Get It," we surely do well to consider what manner of food we are getting in return for life's struggle, whether, in a word, it is pure, clean and wholesome; whether it is calculated to give us the sustenance and strength, the health and prolongation of life that we have a right to expect, or whether it is sometimes so far a mixture of bad with the good, that almost literally we are given a stone when we ask for bread.

This whole question was ably considered by Mr L. S. Dow, before a meeting of the Section of Physics and Chemistry of the Franklin Institute His paper on the subject is here abstracted from the journal of the Institute

"The rapid growth of the preserving business in its early stages attracted much capital without corresponding experience, and in such cases, for the most part, business disaster was only averted by the extensive employment, in nearly everything produced, of chemical anti-ferments, which served as a protection against all the mistakes of cooking, sealing, and sterilization, and obviated entirely the necessity of proper sanitation either in methods or surroundings. The first objection to their use, however, and, I believe the most glaring abuse that exists to-day, lies in the employment for the purpose of preserving partly spoiled and ill-cared-for vegetables and fruits The principal substance that is used for the artificial preservation of vegetable and fruit products, as well as for meats and fish in some cases, is the drug benzoate of soda—which, in its least objectionable form, is a tasteless and odorless derivative of coal-tar.

"It is not my purpose to discuss here the extent to which the substance, sodium benzoate, itself may be harmful. That is a scientific question, the discussion of which I am willing to leave to scientific men, confining myself rather to a few brief words concerning its possible significance in food products But, before proceeding to this phase of the artificial preservative question, I would like to call attention to the fact that the weight of scientific evidence, especially on the part of the medical profession, is strongly opposed to it, and to suggest that if there is a doubt about the amount of injury that it causes, the people, and not the manufacturing interests who desire to continue its use as a means of securing a greater pecuniary profit, should have the benefit of that doubt"

Mr. Dow states that every product of fruit and vegetables with which he is familiar can be successfully made in a commercial way without artificial preservatives, which statement he considers demonstrated because the entire product of at least twenty-five, and probably more, leading American food preservers is entirely free from these substances. "Why, then," asks Mr. Dow, "should any one wish to continue their use? Commercial cupidity yields very grudgingly to attempted reform There is cannery waste to be worked up profitably into ketchups and soups—skins, cores, and decayed parts of tomatoes, cooked up and thrown into barrels to be shipped about the country for use as wanted There are always job lots of spoiled or partly spoiled fruits and other similar materials lying about in the season that can be picked up cheaply To say nothing of the expense attending its proper disposal, it is hard to send such material to the sewer when profit can be gained from it by sufficiently dosing it with a chemical preservative to protect it from putrid fermentation, and then disguising its taint with spices and flavors until it really becomes quite presentable and, in a degree, acceptable to those who do not discriminate very closely in favor of quality, and who are only slowly learning the significance of the legend on the outside of a package 'Preserved with one-tenth of one per cent of benzoate of soda'

"While the demand of the reactionary manufacturer for the continued tolerance of some kind of an artificial preservative is based upon several reasons, the principal pressure in its favor comes from users of tomato waste, which has a commercial importance not generally understood Tomatoes are probably more extensively canned than all other summer vegetables put together—and all the canning is done in a period of six to eight weeks, under high pressure Tomatoes are also more extensively used in soups, condiments, sauces, etc., than any other fruit or vegetable—the consumption of tomato ketchup alone running into many millions of dozens annually"

Mr Dow draws a picture of skins, cores and decayed tomatoes, which there is neither time nor inclination to care for, falling under foot and disregarded as it accumulates Hundreds of thousands of barrels of this refuse, he assures us, are sold in a season

"It is pulped and put into the barrels under conditions that would better be left to the imagination than described, and then chemically 'preserved' against actual putridity It is safe to say that no one would ever again desire to eat any benzoated article after once seeing this material and its treatment

"This tomato refuse is sold at about $1 00 to $4 00 per barrel, to be made into tomato-ketchup soup, baked-bean sauce, etc., which are eventually labelled as made of fresh, ripe tomatoes, and which carry only one protection to the consumer—namely, a statement of the presence of the preservative on every label, which is put there under one of the occasional beneficent food regulations of the Agricultural Department at Washington, but it is always printed as small and obscurely as possible Thus the consumers' only protection is to read all food labels carefully, including the fine print"

Mr Dow states that it is really around the tomato waste industry that has rallied most of the effort for nullification of the Pure Food Provisions of the National Food and Drugs Act

A term much employed by the pro-preservative interests in their defence is "concealed inferiority," the contention being that the addition of a chemical preservative to rotten tomatoes or fruit, for instance, changes neither the odor nor flavor of the material Unfortunately for this line of argument, nobody contends, or ever has contended, that benzoate of soda "conceals inferiority" "The expression 'concealed inferiority" is simply one coined as a premise upon which to build false argument Artificial preservatives do not conceal inferiority, but they do permit and encourage disguised inferiority and the grossest fraud

In order to cheapen the product, Mr Dow states that many manufacturers retain as much water as they may find convenient Bottles and other containers need not be washed, and sterilization becomes a useless expense

"I have no hesitation in saying that the principal use of benzoate of soda and like substances in modern food manufacture to-day is either to permit the use of a lower grade of material, or carelessness in process. Its tendency is to lower quality in some direction all the time, and to invite actually unwholesome practices, and the question of whether we are to have cheapness in our foods at the expense of quality and wholesomeness is as much alive to-day as it was before a food law was placed on the statute books."

The Original Paper Makers

The Paper Wasp and Its Life from Egg Until Death

By Paul Griswold Howes

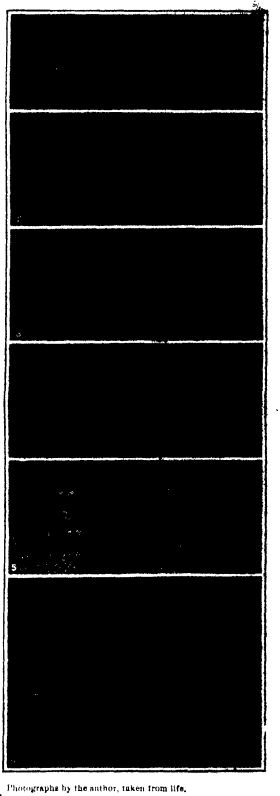
THE communities of the paper wasp, like those of other social insects of the family, consist of three kinds of individuals—males, females and workers. The colonies only exist for a single season, the males and workers dying in the fall. The females or queens hibernate and each starts a new community in the spring. The queen is the largest in the colony and her one duty, after the first few weeks of spring, is egg laying. The males or drones are created for the one purpose of fertilizing the eggs of the queen and after performing this duty they are frequently killed and thrown from the nest by the workers. These so-called workers are in reality undeveloped females who are unable to reproduce in a beneficial way, as their eggs invariably produce drones. Thus they are unable to assist in increasing the numbers of working individuals in the colony and the heavier work must therefore fall upon these otherwise useless members.

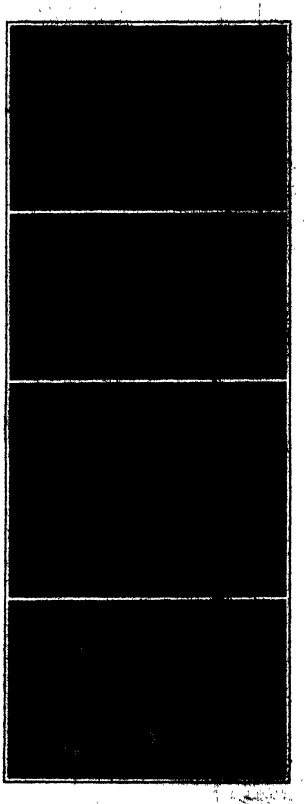
Let us start with the queen mother, the only survivor of last year's colony who has safely passed through the winter in an impregnated and torpid condition and who must now lay the foundations of another great insect city.

When in the spring she lays the first foundations of her future empire, she has not a single worker at her disposal, and with her own hands and teeth she must hollow out a tiny cave wherein to lay the corner stone of her future metropolis. She must herself build the first combs and produce from her own body their first inhabitants, which in their infant state she must feed and educate before they can assist her in the great design. At length she receives the reward for her perseverance and labor, and from being a solitary unconnected individual, in the summer is enabled to rival the queen who gave her birth, in the number of her children and subjects and in the empire of which they are inhabitants. Each at this time, when she has so numerous an army of coadjutresses, the industry of this creature does not cease, but she continues to set an example of diligence to the rest of the colony. If in any way the queen mother perishes before the other females are hatched, the workers lose their instincts, cease their labors and die.

The number of females in a wasp colony is very considerable. They are hatched about the latter part of July or during the first part of August, at the same time and in about the same numbers as the males. In September and October they fly from the nest and after mating the males live but a short time. Of all the females, few survive the winter to start the new empires when the vernal sun brings the insect world to life again.

To the workers falls the entire care of the young and other members of the colony. They must not only supply the food, which consists of honey and chewed up insects, but they must also protect the nest from outside intruders. These poor "Neuters" must also be ready and willing at any time to do construction work upon the rapidly growing nest. Almost daily there are new cells to be built, walls to be strengthened, openings to be closed and all manner of things which only a worker can do. Of all these operations, no other is so interesting as the process by which the wasp's paper is made. It is, of course, manufactured from wood pulp which is scraped by the worker from old boards, fence rails and other unpainted lumber which has been well weathered for two or three years. These tiny particles of wood fiber are mixed by the wasp with a glutinous substance of some sort which is apparently spit up by the worker herself. Now she rolls the whole mass between her fore feet until a small gray pellet has been formed, and with this she flies to the nest. The pellet is then dropped in the proper place and left until the edge of it adheres to the edge of the cell next to which the new one is to be constructed. When this has been accomplished, the insect draws the pulp from a ball or pellet into a long thin line





Photographs by the author, taken from life.

1. The queen mother on her first spring nest. 2. Nest of the paper wasp after the first spring brood have been at work. 3. The same nest two weeks later, a worker is feeding the young. 4. The nest two months old, showing broken cell ears through which the young wasps have hatched. 5. Worker wasps strengthening the central stem which supports the nest. 6. Six months old nest, and its inhabitants dead. 7. Hibernating queens. 8. A warm day in winter brings the torpid wasps to life; the two in the upper left-hand corner are communicating with their crossed feelers. 9. Section of "nipe rail, showing (at the bottom on the right-hand corner) gouges made by paper wasp in collecting wood fiber for pulp. 10. Young paper wasps in the pupal stage.

THE ORIGINAL PAPER MAKERS

body of the young wasp. There it lives feeding upon the body of its host during its hypermetamorphosis. If it is to be a male, it transforms into a chrysalis and soon after this hatches out from the body of the young wasp to live its short adult life, which lasts fifteen minutes to three days. If a female it never turns into a chrysalis, but when the maggot host itself changes into one, the apparently immature Xenos pushes one end of its body out between two of the host's abdominal segments, and there, unlike the female of any other insect family, gives birth alive to a great many tiny beetles in the earliest and most undeveloped stage of their lives.

Owing to the position of the comb, when the young wasp hatches it is suspended head downward in the cell. By means of a glutinous substance (probably the same as the older wasps possess) the larva, as the young one is called, manages to bend itself in place until its head grows long enough to fill the sealing down end. When the larva becomes full grown it spins a cocoon of whitish silk, the bottom of which serves as a cap stone to the cell. In this position the young wasp transforms into a pupa or chrysalis and it is then helpless until the time when it issues as a perfect insect. After this event the cell is cleaned out by the workers and used over again by the queen. The whole period required for the transformation, from the time when the egg is laid until the full grown wasp issues from its cocoon, is about four weeks; thus it will be seen that the same cells may be used many times during a single season.

The last brood of the year consists mostly of queens and drones and after these have been hatched the workers of the colony soon die. The inside of the cells may then be found to contain curious brownish skins, cast off by the chrysalis and which the workers did not have time to remove before the cold weather arrived.

Unlike the large globular nests of the hornets, those of the paper wasps are simply a mass of uncovered cells, ranging in numbers from fifty to five hundred. These are suspended by a single central stem from the under sides of large overhanging stones or from beams in old barns and sheds.

These insects are undoubtedly beneficial from the fact that they have been known to prey upon the destructive rubbage caterpillar in the vicinity of Washington and also in Connecticut. Howard in his Insect Book describes their actions as follows: "The wasps would hover above a plant and then alight and walk about it, but finding nothing, would continue to the next plant and so on to the next. In the sunny center part of the field the cabbage caterpillars were exterminated, but in the shady portions next to a patch of woods, they were present in great numbers. Wasps do not see small objects clearly. They find their prey more by sense of touch than by sense of sight, and as they prefer the sunshine they unconsciously ignored the abundant caterpillars in the shade."

Kirby has left us the following extraordinary account of the manner in which the workers care for the young and helpless members of the community. These observations apply to the common yellow jacket or hornet, but many of the statements hold true in the case of the paper wasps although I have not as yet been able to verify them all. Wild colonies are the most interesting, and the only feasible way to observe them is [illegible]

to the opposite side of the nest. From here she goes back to the start, and places her tong-like jaws over the paper thread, closes them, and simply walks backward away from the point of contact, and thus flattening it into a long gray ribbon which is easily shaped into a low hexagonal cell.

In this manner several layers of paper ribbon are applied, each layer above the other, until the cell is of the proper depth. It is then ready for the delicate white egg which the queen lays almost at its very bottom. The egg is fastened to the paper wall by the same glutinous substance which holds the nest together, and it is almost impossible to remove it without leaving a portion of its tender shell adhering to the wall within the cell.

In the course of a few days the eggs hatch out into soft footless maggots, and it is at this period of their lives that they are subject to the attacks of a very curious beetle parasite called the Xenos. The young of this insect is a tiny active creature which burrows into the

The Home Laboratory

[The Editor of the Home Laboratory will be glad to receive any suggestions for this department and will pay for them, promptly, if available.]

Simple Electric Furnace

By C. C. Kipfinger

THE furnace herewith described was made out of three fire-clay bricks, two three-fourths inch arc-light carbons, a piece of large rubber tubing, a short length of hoop iron, and a bolt. In less than two hours from the time the materials were collected, the apparatus was in good running order.



Fig. 1.—The furnace dismantled.

Fig. 1 shows the various parts before assembling. Two of the bricks have one edge beveled as shown, by means of light blows of a hammer and cold chisel, so that when placed face to face, with the latter edges adjacent, a V-shaped trough is formed. This trough should be of such size that, when the cartons are laid in it, the third brick, which forms the cover, will rest flatly on the sides of the other two. The carbons should fit closely, but not tightly, the cover brick holding them in place. A shallow groove is cut in one of the bevel bricks, at right angles to the trough, leading to the exterior of the furnace. This affords a means of examining the interior during the combustion

A piece of hoop iron, or band iron, is bent so as to form a rectangle which fits the base of the furnace closely. Holes are punched in the ends of the iron and a bolt passing through these affords a means of tightening this binding device. If more convenient, the two bricks may be bound together with heavy iron wire.

The furnace as assembled is shown in Fig. 2. The carbons should be copper plated and have the connections soldered to them, although unplated ones may be used. A short piece of heavy rubber tubing is slipped over the end of each carbon to form an insulating handle, by means of which it may be adjusted with safety. If so desired, a small piece of mica bent at right angles may be used to cover the side opening of the furnace. A delivery tube may be inserted in this aperture, and the volatile products of

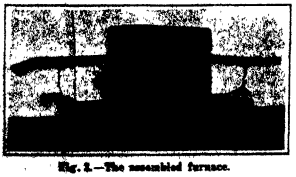


Fig. 2.—The assembled furnace.

the combustion withdrawn by aspiration, for the purpose of their study. Fig. 3 shows the furnace in operation, a spectroscope being used in connection with it as a means of investigating the chemical changes taking place.

It may be found necessary to use a resistance in connection with the instrument. An unplated arc-light carbon makes a very good and cheap one. A resistance is shown in Fig. 3, resting on the sheet of paper at the foot of the furnace. Double brass clips, such as are used in photography to hang prints and films to dry, make very good substitutes for binding posts in this, as well as in other electrical work. The current which is used in the original of this apparatus is 104 volts, 15 amperes, alternating.

The chief merits of the above design are its adaptability, cheapness, ease of construction, and the facility with which it may be cleaned and repaired. Fire bricks can be obtained at almost any furnace room. The capacity of this furnace is small, but the reactions are characteristic. Moreover, it may be used either as an arc or as a resistance furnace For special operations, it may easily be made air tight with a little thick fire-clay, or ordinary clay mortar. The latter

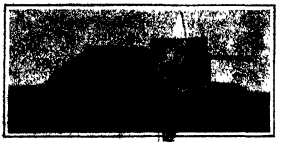


Fig. 3.—Furnace with spectroscope attached.

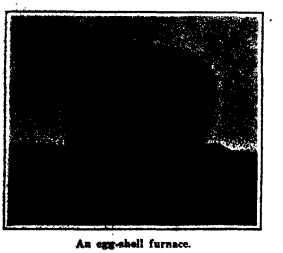
may also be used to repair defects which may develop with continued use.

Calcium carbide, a typical high temperature product, may be made by finely pulverizing three parts by weight of unslaked lime, together with two parts of coal, and subjecting this mixture for an hour to the action of the arc. Many other interesting processes may be imitated on a small scale, and research work carried on with a high degree of satisfaction

An Experiment with Aluminium Powder

By Gustave Michaud, Costa Rica College

THE enormous amount of heat evolved during the combustion of aluminium has been applied, in recent years, to several industrial operations The following easily performed experiment shows in a striking manner the possibilities of the new thermic agent. The amateur is warned, however, that the mixture is highly explosive and must be handled with care, preferably in the open, out-of-doors.



An egg-shell furnace.

Most people would think that the melting of a large gold or silver coin requires some pounds of coal, a furnace and some time The idea is not unreasonable, as gold melts at 1,064 deg C and silver at 960 deg C As a matter of fact, however, a silver quarter can be changed within a few seconds into a liquid sphere with the amount of combustible contained in one half of an egg shell, and in a furnace which is the egg shell itself, no blast whatever being used The feat requires the use of the following mixture

Aluminium powder	17
Flowers of sulphur	15
Saw dust	16
Potassium nitrate	52
	100

The saw dust and the powdered potassium nitrate are dried separately on the kitchen stove When cold they are mixed with the other two ingredients. The mixture is then compressed into one half of a dry egg shell. The silver quarter is laid over it, as shown in the accompanying figure, and a match is applied to the composition. The molten silver coin always collects itself into one single lump, which remains highly luminous some time after the combustion is over.

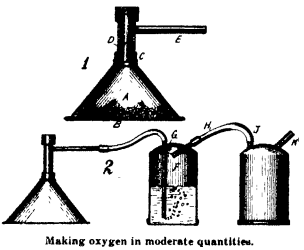
Making Oxygen in Moderate Quantities

By A. J. Jarman

THE experimental production of oxygen upon a small scale with a test tube or glass retort is very useful in demonstrating a chemical point, where only a small quantity of oxygen is needed. When a larger quantity of this gas is required to fill a dozen large vessels or more, for lecture purposes, or for use with the oxyhydrogen blowpipe, for the fusing of metals and other refractory bodies, then resort must be had to a more substantial type of generator The type of retort and the wash bottles here described have been used by the writer for several years successfully, particularly for the production of oxygen for limelight, for stereopticon and dissolving view apparatus, and for lecture room demonstration

There are many handy men who will be able to make both the retort and the wash bottles, these latter being made of zinc Fig 1 shows the body of the retort, which is made of moderately stout sheet iron, with a flange bent outward at the bottom *B* represents the bottom, made of sheet copper The flange of the iron cone being filed clean, the copper is beaten over this flange, then brazed all around in a blacksmith's fire with spelter, using borax for the flux The screw socket at *C* consists simply of an ordinary iron pipe socket, such as is used for connecting wrought iron gas pipe This is also spelter brazed into the top of the cone *D* is a piece of iron gas pipe of one-inch bore, with a screw cap at the top, and *E* is a piece of three-eighths inch bore iron pipe, with a screw at one end, so as to fit into a hole that has been tapped to receive it at the top of *D* This outlet pipe also answers the purpose of a handle for removing *D*, so as to place the charge in the retort, as well as acting as a lever to screw the joint quite tight to prevent the escape of oxygen Fig 2 shows the arrangement of retort and wash bottles when in action generating oxygen The advantage of this kind of retort is that it will resist almost any amount of wear and rough usage At *F* in Fig 2 is one of the wash bottles in section, showing the oxygen passing down the inlet pipe at *G* and through the outlet pipe at *H*, then down the inlet pipe at *J* of the second wash bottle, thence out at *K*, to the receptacle, which may be either a metal gas holder or an India rubber gas bag These inlet and outlet pipes are simply made of the ordinary composition metal gas tubing firmly soldered into the zinc bottles The connecting tube is a good quality of vulcanized India rubber Each of the bottles should hold about three pints

To prepare the oxygen mix one pound and a half



Making oxygen in moderate quantities.

of potassium chlorate in crystals, and half a pound of peroxide of manganese (the ordinary black oxide manganese) The use of the manganese prevents the chlorate from fusing into a mass and aids the production of oxygen The wash bottles must be charged with a pint and a half of cold water The object of this is to absorb and retain any trace of chlorine that might pass over in case the retort became over-heated, and to cool the gas The quantity of potassium chlorate here given will produce well over six cubic feet of pure oxygen—in fact, enough to allow of some waste, which is sure to take place in preparing this gas unless exceptional care is taken As soon as the gas ceases to be evolved, disconnect the tubing, remove the retort from the fire or gas stove, place it upon the ground or stone floor, press one foot upon the side of the cone, give the tube *E* a sharp rap with a hammer, this will start the screwed joint; remove *D* entirely and pour a pint of water (no matter whether it is hot or cold) into the hot retort This will loosen the contents quickly The retort should be well washed out and dried, so as to be ready for future use The water in the wash bottles must be poured off, and the bottles allowed to drain For those who wish to prepare their own oxygen, the following facts may prove useful Eight ounces of potassium chlorate will make, under ordinary circumstances, rather more than two cubic feet of oxygen The chlorate may vary a little in quality, but for all practical purposes these figures will supply the necessary information. Those who wish the information a little more accurate for making oxygen on a small scale will find that one hundred grains of pure potassium chlorate will yield one hundred and eight cubic inches of pure oxygen There are many other chemicals that will yield oxygen upon heating, but there is nothing that will surpass the potassium chlorate and peroxide of manganese mixture.

The Heavens in August

The Brightest Stars of the Month; The Aberration of Light; The Planets; The New Comet

By Henry Norris Russell, Ph.D.



VER our heads, as we look up on a clear August evening, shines a very bright bluish-white star Even a novice in star-gazing will recognize this as **Vega**, the principal star of the constellation Lyra, and, according to the careful measures made at Harvard, the brightest in the northern heavens

For the latter honor it has, indeed, two close rivals, Capella being but seven per cent fainter, and Arcturus ten per cent The very marked differences in color between these stars introduce great difficulties in such a comparison The eyes of different persons are unequally sensitive to light of different colors and an observer who was unusually sensitive to red light would undoubtedly estimate Arcturus to be brighter than Vega In making the comparison it is necessary to choose a time when the two stars are equally high above the horizon, for otherwise the absorption of light in our atmosphere, even in clear weather, makes the star lower down seem the fainter

On photographs, which are far more sensitive than the eye to the blue and violet rays, Vega appears nearly twice as bright as Capella, and fully three times as bright as Arcturus.

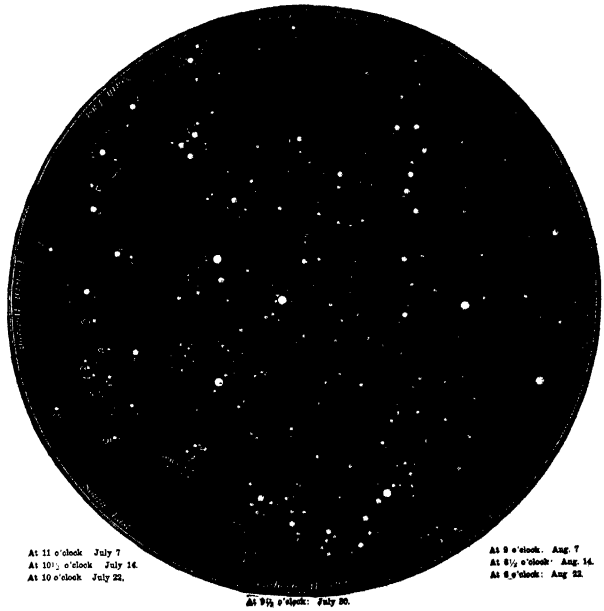
Three stars in the southern half of the heavens—Sirius, Canopus and Alpha Centuri — exceed Vega in apparent brightness, but only the first is visible in our latitude Measures of parallax show that Vega is four times as far away as Sirius so that as a matter of fact it exceeds the latter about three-fold in real brightness

Telescopically, it is interesting because of its great brilliancy, and on account of a faint companion, some 40 seconds distant, which does not share the motion of the bright star, and presumably lies far behind it As our initial shows, Lyra is one more example of a constellation wholly unlike the thing for which it is named Though it boasts no other bright stars, it contains several objects of interest Close to Vega are two small stars, forming with it a nearly equilateral triangle The northernmost of these, Epsilon Lyrae, is just separable by a keen eye, and easily divided by an opera glass A telescope of three inches' aperture will show both components of this wide pair as close doubles, forming a splendid quadruple system The two close pairs are in slow orbital motion, and all four stars are moving together in space

The other star of the triangle, Zeta Lyrae, is a wide telescope double, with separation of 43 seconds A line from Vega through this star carried as far again points out Delta Lyrae—a very wide pair, separated by ten minutes of arc, which is pretty in a field glass Some five degrees to the southwest are the brighter stars Beta and Gamma Lyrae The former (which is nearest Vega) is a remarkable variable and spectroscopic double, consisting of two unequally bright stars revolving almost in contact in a period a little less than thirteen days, which mutually eclipse one another The closeness of positions very a good comparison star makes the variation equal in easy to follow At maximum it is nearly brightness to Gamma Lyrae; at minimum less than half as bright. Almost on the line joining these two stars is the Ring Nebula of Lyra—a beautiful object in a telescope of sufficient power.

Not far from Lyra, and just north of the zenith, is the head of Draco, marked by two bright stars, of between the second and third magnitudes. The easterly one of these, Gamma Draconis, is of considerable interest in the history of astronomy, since it was by observing it that the great English astronomer Bradley, early in the eighteenth century, made the important discovery of the aberration of light.

Bradley's original purpose was to observe the position of this star in the heavens, with an instrument of his own invention, much superior in accuracy to those previously used, in the hope of detecting a yearly change in its position, due to the earth's orbital motion about the sun—in other words, what we now call an annual parallax.



NIGHT SKY: JULY AND AUGUST

If such an effect of the earth's motion should exist, it is clear that the star should appear farther south than usual when the earth was north of the sun (as seen from the star) and farther north than usual when the earth was south of the sun (or the sun north of the earth, which happens in June).

But the actual observations showed a different and very perplexing state of things. The star's apparent position changed, but it was farthest north, not in June, as apparently it ought to have been, but in September—three months late! In June and December, when the effect of parallax should be a maximum, the star's position was almost exactly the same, but between September and March, when no difference owing to parallax could be expected, a large difference was actually observed.

After much puzzling over this strange phenomenon, the true explanation occurred to Bradley while sailing on the Thames, upon noticing that the wind appeared to change in direction every time the boat tacked and changed her course.

Suppose the wind to be blowing from the north, as observed on shore, or on a vessel at anchor. Now suppose the ship to get under way, and proceed due east. In a calm this would apparently produce, for an observer on board, a wind blowing from the direction in which the vessel was heading. The combination of this with the actual north wind would make the wind appear to come from some point east of north. The faster the ship's motion, compared with that of the wind, the greater would be the deviation of its apparent direction.

Now suppose the ship turned about and headed due west. The wind would now seem to come from a point as far west of north as the direction previously observed was east of north. But if the ship was steering north or south, the apparent direction of the wind would be unchanged, though its velocity would seem to be increased or diminished.

Now the light which reaches us from a star, though in other respects quite unlike wind, possesses like the wind a finite velocity; and the combination of this with the velocity of the observer, who is carried along on the moving earth, produces similar effects. When the earth is moving in any given direction — say northward—the light of a star which is not in the line of motion will seem to come from a point farther north than its true position; that is, the star will apparently be displaced to the northward, and *vice versa* if the earth is moving southward.

Now this is exactly what Bradley had observed—the star being apparently farthest north just at the time when the earth is moving northward fastest—or the sun apparently moving southward at the most rapid rate. This occurs in September and all the other observations are equally well explained.

The mystery was thus cleared up. What is more, a conclusive proof had been given that the earth is not fixed in space, but moves around the sun

The rest of Draco winds about, first to the right, then to the left and downward, inclosing Ursa Minor and separating it from the Great Bear, which is descending in the northwestern sky. On the other side of the Pole, Cassiopeia is rising and Cepheus is higher up. Following the Milky Way southward, we reach Cygnus, and then Aquila, in the southeast. The great square of Pegasus has just risen and the line of stars which runs from it through Andromeda and Perseus is near the northeastern horizon. The lower southeastern sky is dull, containing only Capricornus and Aquarius, but the region of Sagittarius and Scorpio, in the south, is one of the finest in the heavens, and contains the brighest part of the whole Milky Way.

Spica Virginis is low in the southwest and much less conspicuous than the planet Jupiter, which is a little to the left. Libra, Ophiuchus and Serpens fill a large area of the southwestern sky. Hercules is west of the zenith, Corona Borealis below, and Bootes lower still, Arcturus being almost due west of the zenith.

THE PLANETS.

Mercury is evening star throughout August, and is best visible before the 12th. His apparent distance from the sun (27 degrees) is unusually large, but, being far south of the latter, he remains in sight for only an hour after sunset and will not be easy to see. Conditions will be most favorable in the early part of

(Continued on page 108.)

The Inventor's Department

Simple Patent Law; Patent Office News; Inventions New and Interesting

Alexander Graham Bell's Ice Stove

A FEW weeks ago we published an article by Mr. W. A. Dupuy on Alexander Graham Bell's ice stove. One of our subscribers has suggested that we publish a picture of the arrangement, so that others may profit by Dr. Bell's ingenuity. The accompanying engraving is the result.

As our readers will remember, Dr. Bell converted his swimming pool into a study and living room. Pipe *A* discharges at *A'* cold air from an ice-box *B* into the lower portion of the swimming pool. In the pipe *A* is placed an electrically operated fan *C*, which receives the air from the ice box *B*, which may be an ordinary ice box, and the air in the pipe *D* leading to the box *B* for supplying fresh air has a suitable valve *E*, by which the supply of fresh air may be regulated. The drawing shows the ice box in a small room adjoining the swimming pool

A Small Portable Ice Machine

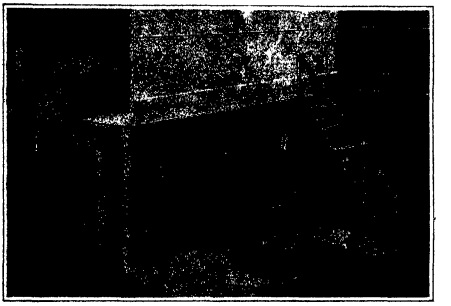
THE modern tendency is toward large scale production. The spinning-wheel may be seen in our homes as an heirloom, but it is silent and unproductive. We find it cheaper and better to have our industries concentrated in large factories, which turn out our clothing, our prepared foods, our ice and what not in bulk. Nevertheless, home "manufactures" have not yet quite passed away, and naturally they too have been modernized by calling to aid the various resources which the development of mechanical and other arts place at our disposal. An instance in point is the ice-making machine shown in our accompanying illustration. This depends for its action upon the well-known fact, that a liquid in evaporating absorbs from its surroundings a certain quantity of heat, commonly termed the "latent heat of evaporation," thereby cooling those surroundings. In order to apply this fact to practical advantage, we need a container from which a suitable liquid, such as water, is evaporated, an air pump wherewith to reduce the pressure above the liquid, so as to cause its evaporation at low temperatures, and finally some absorbent to take up the vapor, and assist in maintaining a low pressure in the apparatus Referring to our illustration, the rotary pump will be seen at the rear on the left, connected by a ruffer suction pipe to the "absorber." This latter is simply a glass vessel containing commercial concentrated sulphuric acid, which should be free from hydrochloric acid. The purpose of the sulphuric acid is to take up the vapor evolved from the water placed in the vessel (a carafe in our drawing) which is being cooled. This vessel is connected to the absorber by an enamelware tube with rubber ends. A block of ice may thus be formed directly in a carafe of table-water, or a suitable wide-mouthed vessel with adaptable cover may be substituted for the carafe, and any material, such as ice-cream mixture for example, can be frozen.

The Ventilation of Sleeping Cars

WHEN Dr. Lorenz, the famous orthopaedic surgeon, was in this country some years ago, he expressed his astonishment that so ingenious and inventive a people should tolerate such an unsanitary abomination as the type of sleeping car used on American railways.

What Dr. Lorenz complained of particularly was the lack of ventilation. That subject was ably discussed in a paper by Dr. Thomas R. Crowder, which was read before the annual meeting of the American Public Health Association. Apparently, the ideas of Dr. Lorenz are all wrong.

Dr. Crowder says: "According to the older theories, the sensations of discomfort arising in inclosed spaces had their origin either in an excess of carbon dioxid or an insufficiency of oxygen. Pettenkofer cast the first serious doubt on the correctness of these theories. Hermans proved



How Dr. Alexander Graham Bell keeps cool in hot weather.

that air containing 15 per cent oxygen may contain 2 to 4 per cent carbon dioxid and not be harmful. On removing the carbon dioxid there was no great discomfort even when the oxygen was reduced to 10 per cent.

"It seems to be established beyond reasonable doubt that discomfort is not due to any change in the chemical composition of the air, but to physical changes only; and that to maintain a normal heat interchange between the body and the air is to avoid the development of those symptoms which are commonly attributed to poor ventilation. A certain amount of fresh air must be supplied, of course, but the most vital element of the ventilation problem becomes that of regulating the temperature of the air. The question of how to ventilate a railway car is therefore chiefly a question of how to regulate its heat."

In cars which are close or stuffy, Dr Crowder says, the temperature is invariably high What is more, a high temperature renders odors more noticeable. The most marked offensiveness that he had ever noticed was in a day coach, where the air was in such a degree of chemical purity as to indicate ideal ventilation by any standard that has ever been proposed



A small vacuum ice machine.

The car was hot and many filthy people in it On the other hand, with perfect comfort has been sometimes associated the highest chemical impurity

"It seems probable, furthermore, that one main cause of the complaint of poor ventilation in the sleeping-car berth is purely psychic We are used to sleeping-rooms with walls and ceilings far from us In the berth they are very close Their very nearness is oppressive It seems as if there cannot be enough air in this small space to supply our wants The sensation is often quite independent of the amount of air supplied and even of the temperature.

"Even under the older applied principles of ventilation, the air-supply of sleeping-cars, as determined in this study, is ample under nearly all conditions. The average carbon dioxid in the air of running cars falls well within the limits of contamination permitted by the earlier investigators, and it is relatively rare that the individual observations show more than 10 parts in 10,000. In the light of the newer conceptions, which have as yet been applied in practice only to a very limited extent, this air-supply is ample under all conditions observed. No danger to health is to be apprehended under the conditions ordinarily obtaining even in still cars They are occupied only for short periods as a rule and are not uncomfortable if kept cool"

In Dr Crowder's opinion, "the results obtained by the type of exhaust ventilator which is now a part of the standard equipment of the Pullman cars, are entirely adequate to meet the demands of hygiene, and that those difficulties and discomforts which do sometimes arise are due to other causes than lack of a sufficient amount of fresh air or to excessive vitiation It is extremely unlikely that increasing the air-supply, which now amounts to from six to ten or more times the cubic content of the car each hour, and must maintain considerable motion of the atmosphere, would and in any other way than by making overheating more difficult to bring about

"Overheating is the paramount evil It is the thing to be chiefly guarded against in the attempt to maintain comfort and good hygiene It is not feasible to cool the naturally overheated air in summer, or to dry it when excessively humid Fan *motors* and *open windows* are the available means by which the difficulties arising in hot weather may be most readily overcome. Carry away the body heat as rapidly as possible by a strong current of air.

"Though the avoidance of overheating in winter would seem to be an easy thing, its accurate control to meet the rapidly changing conditions under which cars may be operated is a matter of great difficulty. Experience has shown that it is necessary to have in sleeping-cars at least twice as much radiating surface as is demanded in common practice for heating the same space in houses, this in order to warm the large volume of air received and discharged so that it will maintain comfort to inactive passengers. To decrease this surface would be to fail to maintain a sufficiently high temperature on occasion

"A system is needed capable of being quickly and effectively controlled to meet rapidly changing conditions Such a system is now being experimented with in which there are multiple units of radiating surface, each with a separate control The results so far indicate that from this a more uniformly comfortable condition can be maintained."

Notes for Inventors

Running a Typewriter With a Perforated Roll.—The problem of manifolding typewritten letters has given inventors no little concern It frequently happens that thousands of letters, all of them alike, are sent through the mails, letters which are in reality circulars in epistolary form, each of which must appear as if it were intended only for the particular recipient into whose hand it falls The market is now almost overcrowded with duplicating machines of various kinds, which imitate, with more or less success, typewritten work One of the most ingenious solutions is the application to the typewriter of the perforated paper roll, which has made the automatic piano player possible. As might be expected, the inventor who has done this, Mr John McTammany, has been identified with the automatic piano player ever since its inception In fact, he has good reason to regard himself as a pioneer inventor of the automatic piano player Mr. McTammany has invented a machine which is to be used

in connection with the ordinary typewriter, and which may be best described as the mechanical equivalent of a pair of hands, capable of turning out ten thousand letters a day. Each letter is an original. As in the automatic piano player, a perforated paper sheet is used. This sheet, whose perforations correspond with certain letters on the typewriter keys, however, does not cause a series of pneumatics to operate, in order to depress the keys of the typewriter, but controls a series of star wheels which actuate the keys. The paper strip is positively fed. By abandoning the pneumatic system of the piano player and yet retaining the perforated roll, the inventor has succeeded in producing a machine which is remarkably compact.

Appreciation of Invention.—It is interesting to note the importance ascribed to inventors and invention in practically all discussions of the developments of business. In a recent article in a popular magazine along the line of business aids and occupying only four short columns, we find reference in three of the columns to three separate inventions, two of which were made by *attaches* of the same business establishment, which is described as encouraging and assisting originality in inventions that can be patented. In explaining his advancement, one of the successful men in the big establishment is quoted as saying that he began making inventions or improving some inventions made by others, and that he was then engaged in the development of another invention.

A Mechanical Violin.—An instrument in the general form of a piano, but seeking to secure the effect of a violin, is sought in a patent, No. 996,614, to Andrew M. Carlson of St. Paul, Minn. He provides in connection with a stringed instrument like a violin two bows near each other upon the same string. These bows are reciprocated in contact with the string slowly at the same speed in one direction and for a part of the stroke simultaneously and are given a more rapid return movement. During the slow movement in contact with the string, the bows are applied to the string partly one at a time and partly both at the same time, so that each bow will continue the note the previous bow is playing before the previous bow leaves the string to make its quick return stroke. A keyboard is provided for pressing mechanical fingers against the strings by power and this keyboard controls the power so it is applied to the right fingers and at the right time.

An Advertising Device.—In a patent, No. 996,929, to Charles W. Saalburg of New York as assignee of Hans Kempinski of Berlin, Germany, is shown an exhibiting device for use in show windows and similar places, including a tank and a bottle above the tank and tilted to discharge liquid into the tank. Liquid is supplied to the bottle by a tube extending upwardly from the tank and through which the water from the tank is forced by a pump. The tube enters the neck of the bottle and the tube is bent between the tank and bottle to conform to the trajectory formed by the liquid pouring from the bottle into the tank so the tube will be within and concealed by the stream of liquid falling from the bottle.

Six Patents to One Inventor.—William D. Forsyth of Youngstown, Ohio, recently obtained on the same day six patents numbered from Nos. 996,620 to 996,634 inclusive. Two of these patents are for metallic railway ties, one for a brake beam, one for a rail joint, and another for a reinforced concrete cross tie, and one for a truck side frame for cars, the latter being assigned to A. M. Neeper of Pittsburg, Pa. It will be noticed that all of the patents relate to the rolling stock or the roadbed of a railway.

A Combined Flying Machine and Parachute.—A flying machine whose planes normally assume a comparatively flat form, but which can be distorted by mechanism controlled by the aviator into the form of a parachute, is presented in a patent, No. 997,122, to Otto A. Fenn of New York.

A Novel Ice-machine.—A patent, No. 993,771, has been issued to Joseph B. Gallagher, of Glen Ridge, N. J., assignor to a New Jersey corporation, for an apparatus for making plate ice including a tank and a vertically arranged freezing plate, combined with a band saw and operating means for the band saw and means for feeding the band saw upwardly in order that it may separate the cake of ice from the freezing plate.

A Guard for Stick Pins.—A stick pin fastening forms the subject of a patent, No. 996,298, to Adinius R. Sunde, of Antonito, Colo., its novel feature being a retaining prong at the back of the head of the pin and spaced away from the head so that, when inserting the pin, the head can be turned slightly to throw the prong away from a neck tie and when the pin is inserted, the head can be partially rotated to force the prong horizontally into the tie.

A New Hydraulic Ram.—An improved hydraulic ram is presented in a patent, No. 996,056, the invention of Edward R. Brodton of Mobile, Alabama. In this patent a water wheel is placed in the casing of the ram and the waste valve of the ram is operated by the water wheel to closed position, the normal tendency of the valve being toward open position.

A Patent to Edison.—Thos. A. Edison has obtained a patent, No. 996,070, for a rotary kiln for cement. The kiln comprises a long tube which is rotated and has a combustion portion at one end. At its other or upper end the tube is of a greater diameter and is divided into a number of passages.

Patents Assigned to Large Companies.—Nothing better illustrates the high estimate in which patents are held by the business public than the attitude toward them of large business corporations, such, for instance, as the General Electric Company, the Westinghouse Co. and the United Shoe Machinery Co. It appears from the list of patents issued June 27th, 1911, that on that day alone four patents were issued to the United Shoe Machinery Co., as assignee, while on the same day more than thirty patents were issued to the General Electric Co., as the assignee of various inventors including among the number such distinguished inventors and scientists as Elihu Thomson and Chas. P. Steinmetz.

A Portable Bathtub.—In traveling in remote sections bathing facilities are not always available. Warren C. Callahan of Louisville Ky., provides for this in a patent, No. 996,453, by a portable bathing apparatus in which a hoop made of a number of flexibly connected sections so it can be easily collapsed by swinging the sections face to face for convenience in carrying, is set edgewise and a water proof cloth is placed over the hoop and depressed within the hoop so the interior of the hoop forms a tub to hold the water while bathing and the edges of the sheet can after the bath, be brought together forming a water bag to carry the water to a disposal point.

New Wireless Patents.—A number of patents, Nos. 996,088 to 996,092 inclusive, have issued to Maurice Bernays Johnson of San Antonio, Texas, for inventions relating to wireless telegraphy and telephony. One of these patents, No. 996,089, is for a combined wire and wireless telephone system, and another, No. 996,089, is for a combined wire and wireless telegraph system, the former including a wire line at the central station and wireless instruments also at the central station and arranged for connection with the wire line; and wireless communication is established between a transmitter at one end of a space and a receiver and transmitter at the other end of the space, the latter receiver operating its transmitter, switches being provided for connecting the wire line with the wireless instruments and for connecting the wireless instruments with the central operator.

RECENTLY PATENTED INVENTIONS.

These columns are open to all patentees. The notices are inserted by special arrangement with the inventors. Terms on application to the Advertising Department of the SCIENTIFIC AMERICAN.

Electrical Devices.

ELECTRICALLY CONTROLLED CLOCK AND TIME INTERVAL TRANSMITTER.—S. I. AIKEN, Fort Mills, Corregidor, P. I. This invention is particularly applicable to time interval signaling, such as time interval apparatus for artillery fire control, or for other analogous uses employing instruments in which absolute chronometrical accuracy, irrespective of the size, or the weight of, or the load imposed upon the controlled mechanisms, is essential.

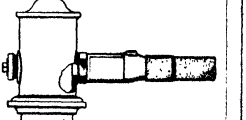
Of General Interest.

COMPOUND FOR TREATING STEEL.—HARRY M. LEE and FRANK G. BOOTH, New London, Conn. It has been found that by using the solution of this invention as a hardening solution, steels can be hardened to the same degree without the necessity of previously heating the steel to an excessive amount, as has been found in the case of certain types of steels when using other hardening solutions. This solution may be also used in drawing the temper of steel, and in such a case, it is heated to the desired degree and the steel placed therein until the temper has been drawn the desired amount. Since the patent was issued this process has been tried out in large machine shops throughout the country and it has proven highly successful. The patent has been assigned to the Steel Tempering Process Company, 37 Pine Street, New York, N. Y.

ARTIFICIAL RAWHIDE LEG.—W. H. VANORMAN, Auburn, N. Y. The purpose of this invention is to provide an improved ankle joint. It consists in pivoting the leg portion on an axis longitudinal to the foot and on an axis transverse to the foot with the axes intersecting, and with the bearings for the transverse axis confined together with means for limiting the movement of the leg portion on the transverse axis.

PROCESS FOR STRENGTHENING CELLULOSE.—X. ESCHALIER, Rue des Fleurs, Villeurbanne, Rhone, France. The invention relates to a process of strengthening cellulose bodies, more particularly the depolymerised cellulose bodies in various stages of hydration, produced from solutions in the different solvents. The strengthening according to this process, is in the nature of a polymerisation or a condensation, its effect being very appreciable in the dry State and especially so in the wet.

HOSE COUPLING.—HIRAM W. PETTINGILL, 510 West 58th Street, Seattle, Wash. This invention is an improvement in hose and pipe connections and has for an object to provide a construction in which one of the coupling members will be provided with a packing arranged to be actuated by the pressure of the



HOSE COUPLING.

fluid within the coupled pipes in such manner as to render the pipe joint perfectly tight. It may be utilized in coupling air, water or other fluid bearing pipes and is such as to permit the convenient connection and disconnection of the pipes whether it be applied in connection with a hydrant, as shown in the engraving or in coupling two pipes or hose.

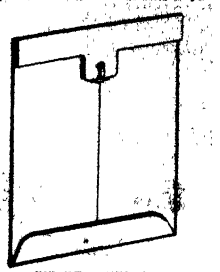
CLEANING PAPER AND PROCESS OF PREPARING THE SAME.—J. R. SMITH, Moline, Ill. This invention is an improvement in a process of treating paper, and the object is to provide a process of this character specified for producing a paper especially adapted for dry cleaning and polishing glass, or the like, without the use of extraneous matter such as soap or cleaning powders.

MOLD FOR CONCRETE STRUCTURES.—J. S. LINTON, Chicago, Ill. The improvement provides a mold or form for making concrete structures, such as walls, columns, beams, etc., and arranged to securely hold the mold parts in position, to allow of raising the mold as the building of the structure progresses, and to temporarily support the concrete material to be used in the formation of the structure.

BAG HOLDER.—P. C. MCCASKILLEN, Walla Walla, Wash. The invention relates to holders for paper bags or similar articles, and has reference more particularly to a device of this class which comprises a frame having both a socket adapted to receive and to hold a plurality of bags, a hook, and a spreader member for releasably holding the bags against the back.

NON-SIFTING ENVELOP.

BUTTON, 216 So. West Temple Street, Salt Lake City, Utah. The object here is to provide means in connection with the envelop for closing the mouth thereof in such manner as to prevent the escape of contaminated or pul-



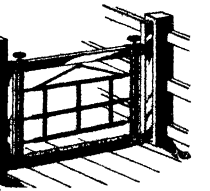
NON-SIFTING ENVELOP.

verulent substances at the end of the flap, where in the ordinary form of envelop there is an opening between the sealing flap and the back of the envelop. It is designed more especially for carrying merchandise. The envelop illustrated herewith has a sealing flap whose inner portion is a double ply, while its outer is a single ply, and the flap folds by folding the single ply onto the double and then folding the single and the double ply onto the envelop.

DETONATOR.—R. A. MOORE, Portsmouth, Ohio. In the patent the invention has reference to an improvement in detonators, and the object is to provide means on the end of a cane which can be operated by bringing the cane down upon the ground forcibly, whereby an explosive tape will be fed and exploded.

PLUG STOP.—J. ARMSTRONG, Alvo, Neb. The invention in this instance has for an object to provide a fine stop for securing a fine cap to a fine hole, to prevent dust, smoke, or soot from passing through the fine hole into a room. For this purpose use is made of pivotally connected bars having lateral flanges thereon and adapted to be removably engaged by a holding screw connected with a fine cap.

GATE.—EDWIN COWELL, 969 Atlantic Avenue, Brooklyn, New York, N. Y. This invention provides a gate for stopping runaways on bridges, roadways, and the like without injuring the runaway in the act of stopping the same. For this purpose, use is made of a frame preferably adapted to swing on a post and having an extensible baffle mounted



GATE.

thereon, adjusting rollers being connected with the baffle to normally adjust the same after the baffle has been extended, and the lower side of the frame being preferably padded to ease the force of impact of the runaway against the gate. The device is shown in the perspective illustration in operative position. Precedent authorities on veterinary matters have indorsed its practicability, among them Dr. William Sheppard, a member of the Royal College of Veterinary Surgeons, London.

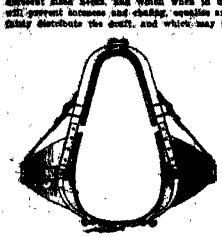
Hardware and Tools.

EARTH BORING AUGER CUTTER HEAD.—F. A. BOUCHET, Merced, Cal. The head has a cutting blade shaped and arranged to form a small centering bore in advance of the main bore. The invention also provides in connection with a cutting blade adapted to form the main bore, a second blade whereby the cuttings from the main blade are broken into smaller particles for the freer delivery from the bored hole; and provides means for dividing and guiding the washing water delivered to the bottom of the bored hole between the blades to elevate the cuttings from the bottom of the bored hole.

PLUGS, WEDGES, ETC.—O. SAMUELSON, Ishpeming, Mich. In the [illegible] of the type comprising a [illegible] and [illegible] [illegible] [illegible]

...ers are forced to the rear to retain the elevator in closed position by a resilient compression spring, in this manner producing a strong and compact hinge structure.

COMBINED HAMES AND COLLAR.—ERNEST SIEBER, Wren, Neb. Mr. Sieber's invention provides a uniform combined collar and hames whereby to dispense with the usual collar and hames, which may be adjusted for different sized teams, and which when in use will prevent sweeney and chafing, equalize and fairly distribute the draft, and which may be

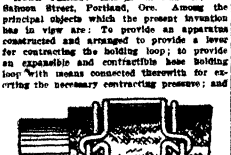


COMBINED HAMES AND COLLAR.

easily placed and removed. The illustration shows the improvement in the position it will occupy when in use, and to remove it, it is only necessary to release the free end of a strap from a buckle. This free end may be now withdrawn from a loop and a ring, when the improvement may be moved from the beast's neck. No injurious strain is brought to bear in any part, the draft being equalized.

SPRAYING NOZZLE.—G. L. GLASER, New York, N. Y. This nozzle is for use in the uniform and economical distribution of water in the form of light or heavy sprays for irrigation, or for spraying water, insecticides, and other liquids for agricultural and horticultural purposes, also for the equal and economical distribution of water and other liquids for fire extinguishment, and for other purposes where the spray may be advantageously used or applied.

HOSE CLAMP.—HAROLD R. FRANCIS, 474 Salmon Street, Portland, Ore. Among the principal objects which the present invention has in view are: To provide an apparatus constructed and arranged to provide a lever for contracting the holding loop; to provide an expansible and contractible hose holding loop with means connected therewith for exerting the necessary contracting pressure; and



HOSE CLAMP.

to provide means for contracting the clamp and automatically locking the same in contracted position. The engraving shows a side view of a clamp constructed and arranged in accordance with the invention, shown in connection with a pipe hose section, and in locked relation thereto.

CLAMPING DEVICE.—DAVID D. THOMPSON, care of Faber Bros., Fort Pierce, Fla. This invention is illustrated herewith and shows the device in the act of holding a door in an upright position. It relates more



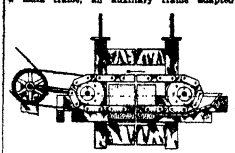
CLAMPING DEVICE.

particularly to devices which are adapted to be used for holding objects, such as doors, blinds, or the like, in a vertical position so that their edges may be planed or fitted with hinges, and comprising jaw members adapted to be moved into engagement with the sides of an object to hold the latter in position. The device in use enables the operator to have both hands free for planing or performing other work on the object so secured.

LOCK.—E. HAMMOND, New York, N. Y. The invention has for its object the provision of a lock which will be durable in construction, strong, efficient, and will permit parts subject to accidental breakage or portion of the lock to be removed, or both easily with the use of a key, to permit the lock to be operated by either side of the door, and which is adapted for differently swinging doors, by having the face plate beveled and removable, and the openings therein located symmetrically.

Machines and Mechanical Devices.

STONE SAWING MACHINE.—HENRY Q. MACKINO, Albuquerque, New Mex. This invention relates to sawing stone and the machine is shown in sectional side view in the illustration. The object is to provide a device for sawing stone, such as marble and the like. For this purpose use is made of a main frame, an auxiliary frame adapted

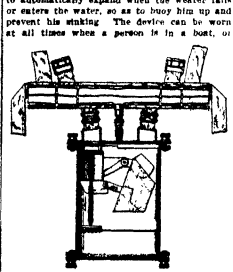


STONE SAWING MACHINE.

to move vertically, and mounted on the main frame, an auxiliary frame adapted to move horizontally and mounted on the first auxiliary frame, means for moving the vertical frame, means for moving the horizontal frame, rollers on the horizontal frame, and a chain of saws mounted to turn on the rollers, and adapted to saw stone

PACKAGING MACHINE.—M. F ANDERSON, New York, N. Y In this instance the object of the invention is to provide a new and improved packaging machine, more especially designed for packaging rolls of oilcloth, wall paper and the like, in a very simple manner, in compact form and in a comparatively short time, each package containing a number of rolls.

AUTOMATIC LIFE PRESERVER.—EDWARD W. MILLER, Merrick, N Y. The invention pictured in the accompanying engraving relates to an automatic life preserver of a type adapted to automatically expand when the wearer falls or enters the water, so as to buoy him up and prevent his sinking. The device can be worn at all times when a person is in a boat, or



AUTOMATIC LIFE PRESERVERS.

in danger of falling into the water. It is out of sight and unobtrusive when not in actual use, and will immediately expand when the wearer goes into the water, so as to form a buoyant support which will prevent him from sinking, by means of a gas generated on entering the water, which is collected in a substantially fluid-tight envelope

CAMERA EXPOSURE INDICATOR.—C. G IVAS, Norwalk, Conn. This invention provides an attachment to the camera whereby an indicator will denote that a film has been exposed when the shutter is operated. Use is made of an indicator for automatically indicating an exposure when the shutter lever is operated and a connection between the indicator and the film winding mechanism of the camera whereby the indicator is returned to normal position when the exposed film is wound on the winding mechanism.

ELEVATOR.—R. E. SHOWDEN, Snowden, N. C. Pivoted buckets carried by belt members, are provided by this invention, the buckets being free to swing through the belt members and there being means to move the buckets relatively to the belt members. Another object is to provide wheels, having spokes with seats for engaging and directing the belt members. Another is to provide the spokes with members for engaging the buckets and holding them in position relatively to the belt members.

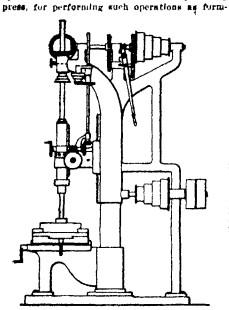
MEANS FOR PRIMING CENTRIFUGAL PUMPS.—L. DESMARAIS, 10 Rue du Banquier, Paris, France. The priming of a centrifugal pump by using the air suction of one or several cylinders of the motor serving to drive the pump, is effected in this invention. The invention applies to any pump-installation, fixed or movable, operated by a motor whatever be its system, steam, compressed air or other, provided that one of the elements of any kind of the motor normally taking part in its working, can be utilized momentarily as suction pump for the priming of the operated pump which being a centrifugal pump, can only suck when it is primed.

DEVICE FOR CARVING AND GAINING.—R. G GUPTILL, Ravia, Okla. The object here is to provide means by which the carving or gaining can be done by machinery without necessitating the use of saw, hammer, chisel or bit and brace A further object of the invention consists in the provision of the device by which stair strips may be gained and which will permit the movement of the stair strip in any direction thereby facilitating the operation

SUGAR WASHING MACHINE.—A. PLESCHER and F. KAMPAN, Las Animas, Col. An object of this invention is to provide a device which will automatically wash a charge of sugar, and when sufficient water has been supplied will shut off the supply. A further object is to provide a reciprocating washing device, the movement of which is accomplished by means of the water, which is used in the sprinkling operation

SAFETY SPRING BARREL.—R L. MARSHALL, Elisabethtown, Ky. An object here is to provide a spring barrel for a watch, disposed upon a solid arbor which extends through the entire length of the barrel, thereby insuring stability A further object is to provide a device in which the size of the jewel holes are reduced, thereby lessening friction, without sacrificing stability

RECIPROCATING AND ROTARY PRESS.—JAMES D. MCCLELLAND, Jr., 40 West 6th Street, Mount Vernon, N Y This invention relates to a machine drill, which can be used either as a drill press for performing drilling operations on the work or as a reciprocating press, for performing such operations as form-



RECIPROCATING AND ROTARY PRESS.

ing mortise and tenon joints, key-seating, face planing, or the like A further object is to provide a machine tool which can be readily changed so as to operate either as a drill press or a reciprocating press, by connecting one or the other portion thereof in driving relation with the main drive The accompanying illustration shows the press in a side view

REGISTERING DEVICE FOR TYPE WRITERS.—H. HARMON Kalispell, Mont The invention is an improvement in registering devices for typewriters, and the object is the provision of a simple, compact, and accurate registering device for attachment to any approved form of typewriter, which will correctly register the number of words written, and which may be easily attached and detached

FLYING MACHINE.—A. H FRISBEL, Baltimore, Md One of the objects in this case is an improved construction of flying machine embodying extensible controlling devices in the nature of slides or curtains which may be opened or stretched at the will of the aeronaut for the purpose of steering to the right or left, or for overcoming the momentum of the apparatus

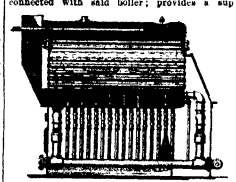
APPARATUS FOR CONDENSING FIBROUS MATERIALS PREPARATORY TO SPINNING.—B BONIE, Werdau, Germany The invention has for its object a roving machine especially designed for treating tow waste and other difficult materials, comprising a film divider and condenser, and characterized by the provision of special means for preventing the films from becoming wound around the edges of the dividing bands or adhering to the same.

Prime Movers and Their Accessories.

INDICATOR FOR SPARK PLUGS.—A. R LAMBERSON, Albany, N Y. In this invention the improvement relates to indicators for spark plugs, the more particular purpose being to provide an indicator having generally the form of a testing tube into which the operator may look in order to ascertain the electrical condition of a spark plug to which the indicator is applied

ROTARY ENGINE.—J. M. FOY, Palatka, Fla. The object of this inventor is to provide an internal combustion, rotary engine which is compact in form, and can be exactly governed, in which the exploded charges are thoroughly scavenged from the cylinders, in which the exhaust gases are to a large extent carried off from the vicinity of the engine, and by means of which any desired number of explosive cylinders can be combined in one prime mover

STEAM BOILER.—NICHOLAS A UHEN, Jr care of Arlington Hotel, Seattle, Wash The invention illustrated here with provides for a boiler a supporting structure formed of water circulating tubes connected with the boiler drum; provides for a boiler of the drum type a fire box, the side and head walls of which are formed in part by water circulating tubes connected with said boiler; provides a sup



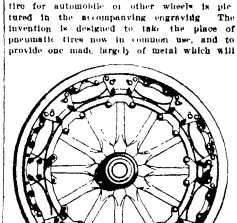
STEAM BOILER.

porting structure for the drum boiler so as to avoid lateral extension of the fire box, provides a water circulating system embodying circulating manifolds, provides a connecting pipe between said manifolds to balance water supply therein, and provides a supporting structure for the drum boiler constructed from tubes having screw threaded connections by the manipulation of which the horizontal arrangement of the boiler may be varied

Pertaining to Vehicles.

AUTOMOBILE TORPEDO.—A E JONES, Flume, Austria Hungary The object here is a percussion mechanism or pistol for automobile torpedoes The invention aims more particularly at permitting of the release of the striker no matter at what angle the torpedo strikes its mark, while at the same time avoiding any incorrect operation and the cocking of the striker before and during firing and so long as the torpedo is in proximity to the vessel from which it is launched

FLEXIBLE METALLIC TIRE.—WILLIAM C NICHOLSON, Crown Point, Ind A flexible tire for automobile or other wheels is pictured in the accompanying engraving The invention is designed to take the place of pneumatic tires now in common use, and to provide one made largely of metal which will



FLEXIBLE METALLIC TIRE.

have resiliency and durability, but not be subject to the annoyance of puncture and other inconveniences arising from use of pneumatic tires The tire has sections, each being movable against springs so that as the wheel is rotated, the load comes successively upon the separate sections which give slightly, in the manner of the pneumatic tire.

Railways and Their Accessories.

RAIL JOINT.—E. J DAVIS P O Box 110, Altheimer, Ark This invention is an improvement in rail joints and has for an object to provide a construction whereby to support the rails at the joints as thoroughly and efficiently as they are supported at other points with a special view to overcome the difficulties resulting from low joints incident to the ordinary rail joint now in common use.

Designs.

DESIGN FOR A PENCIL DISPLAY STAND.—W H DALTON, West Hoboken, N J In this ornamental design for a pencil stand, the stand comprises a flat base of curved outline on which are placed the four perforated uprights that hold the pencils A center piece culminating on a point caps the stand and producing an attractive design.

NOTE.—Copies of any of these patents will be furnished by the SCIENTIFIC AMERICAN for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

Notes and Queries.

Kindly keep your queries on separate sheets of paper when corresponding about such matters as patents, subscriptions, books, etc. This will greatly facilitate answering your questions as in many cases they have to be referred to experts. The full name and address should be given on every letter. No attention will be paid to unsigned queries. Full hints to correspondents are printed from time to time and will be mailed on request.

(12501) F. M. E asks. Is it worth while for some of our aviators to watch for an opportunity and rise in the wake of a rain cloud and see the rainbow a complete circle? It would certainly be a beautiful spectacle and will be seen by very few. A Whether one would think it worth while to rise in the wake of a rain cloud on the chance of seeing a complete rainbow, we cannot say. It would be a unique experience, if it should be successfully accomplished.

(12502) J. W. C asks. 1. A cubic foot of air in a globe or vessel that weighs, say 2 pounds, would require a certain weight to sink it in water. Now if it is compressed to 64 cubic inches, and the container is same weight, would its buoyancy be the same, or would more or less weight be required to sink it in water to same depth? A. A cubic foot of air at ordinary density weighs about an ounce and a quarter. If it is in a globe which weighs two pounds the whole will weigh the sum of two pounds. If the globe has a volume of one cubic foot, it will displace a cubic foot of water, which weighs if fresh about 62½ pounds and it will be buoyed up by a force of about 60 pounds 6¾ ounces, the difference of the two weights. Now, if the air be compressed to 64 cubic inches, it and its container will weigh the same as before, but will be buoyed up by the weight of 64 cubic inches of water, which you can calculate from the weight of a cubic foot as given above. It will find that the globe will just float in fresh water, the buoyant force being only a very few ounces. 2. What would be the pressure per square inch if a cubic foot of air is compressed to 64 cubic inches? A. If a cubic foot of air is compressed to 64 cubic inches, the pressure at the same temperature will be twenty-seven times the normal pressure, which is 405 pounds per square inch. 3. Have you any books or papers that would be of assistance to a novice in building small rowboats and motorboats? If so, please give me price of same, or tell me where I can get such books. A. We can supply the following books on boat building: "Practical Boat Building for Amateurs," by Nelson, $1; "Canoe and Boat Building for Amateurs," by Stephens, $2; "Nine Motor Boats and How to Build Them," $1; "How to Build a Motor Launch from Plans," by Davis, $1.50; "How to Build a Motor Launch," by Mower, $1. Upon receipt of the prices quoted above, we will forward these books postpaid to your address.

(12503) G. K asks. My friend's boy, a youth of 15 years, came to me and asked me if him made into powder form could be electrified, either with positive or negative electricity. Further, he wished to know what the result would be if both powders were blown through a pipe, one separate at the point of contact. A. Powdered iron can be electrified if it is insulated, and if it were blown from a pipe while charged with either positive or negative electricity, the particles of iron would repel each other and fly apart in all directions. If there were two iron powders, one electrified positively and the other negatively of equal quantity, upon mixing the two powders they would be attracted each other and there would be no charge of electricity left since iron is a conductor of electricity, and can retain it only when it is insulated. We hope that this explains what your young friend wished to know. It would be profitable for such a young man to have the SCIENTIFIC AMERICAN for himself. We hope he may become a subscriber to it.

(12504) A. C. M asks. Will you please be so kind as to give me a formula in your queries column for making a nickel plating solution for electroplating? A. For a small bath for nickel plating dissolve 12 to 16 ounces of the double sulphate of nickel and ammonium, per gallon of water in a stone jar which is perfectly clean. Add water till the solution is of a density of 1.04 to 1.06, or from 6.5 deg. B to 7 deg. B. For large baths a very different method is taken to shorten the time. You will find full instructions in Langbein's "Electro-Deposition of Metals," $4, or in Watt's "Electro-plating," $4.50. A very good small book of very practical instructions is Van Hornes "Modern Electroplating," $1. We shall be pleased to supply any of our readers with these books upon receipt of price.

(12505) W. S. K asks. Can you furnish us the address of a concern where I can buy a microscope? It is used in enlarging of pictures etc. I have never seen one and can only give you an idea of it. It is made of glass. A. We do not know any instrument which is kept for sale to be used in enlarging pictures. This is usually done by dividing the picture into squares, and the paper upon which it is to be copied into the same number of squares. Then, as you will see, any portion of the picture will be drawn to fill the square on the copy which corresponds to the square which it fills in the original picture. A plate of glass ruled in squares and over the picture would be very convenient but you can rule fine pencil marks over a picture and afterward erase them, or you can make a light frame and draw a thread across it to form the squares. Other ways will suggest themselves to you for making the square, cheaper than buying a frame.

(12506) D. S asks: 1. Supposing that a retort or any other receptacle was filled with pure air (with of course provision for its expansion) and heat was applied to the outside of the retort sufficient to raise the temperature of the air in the retort to say 1,000 deg. or 1,200 deg., would that air be fit to breathe after it was cooled to the ordinary atmospheric temperature? A. If pure air containing only oxygen, nitrogen and the other gases which are found in minute quantities in pure air should be inclosed in a retort and heated to 1,500 deg. Fahr., and again cooled, no change would take place in the air. It would be the same as before the heating in every respect. It could be breathed with entire safety. 2. About what proportion of the oxygen would remain in that air, or would nearly all of the oxygen be burned out of it, being as it were entirely isolated from the outside fire? A. The oxygen of the air could not burn with any other substance in pure air in the retort. To cause the oxygen to combine with the nitrogen a temperature very much above 1,500 deg. Fahr. is required. None of the oxygen would be burned at that temperature.

(12507) W. H. P. asks. 1. In the practice of wireless telegraphy does the circuit run thru the air, or do they use the air as one wire and the ground for the other? A. A wireless telegraph message is not sent by means of an electric current flowing over a circuit as ordinary telegraph messages are sent. It is sent by means of waves which are sent off into space by the energy of the transmitting apparatus. In the present method of signaling the waves remain fixed to the surface of the earth, and spread in this manner outward in all directions from the aerial wire. Over water they flow with little retardation. Over the earth they follow the surface, up and down as may be, and are impeded so that they die out sooner and do not reach as far as over water. They do not act at all as if they were following a wire. 2. Is there a way in which the receiving instrument of wireless telegraphy can be arranged so that it will be able to receive from a fixed distance from a mile of the transmitting instrument before it can receive a message, and can receive a message all the time within the radius of this distance? A. The receiving instrument can receive audible any signal which is powerful enough to affect it. It is a matter of the sensitiveness of the detector. The receiver must be tuned to the same wave length as the transmitter and the detector can then pick out the signals that it is adapted. It is not so much the distance from which the signals have come as the energy of the signals and the delicacy of the receiving apparatus.

(12508) W. A. W asks. 1. How is it possible when listening to a phonograph to hear more than one sound at the same time, although only one needle and one diaphragm, which I assume can only vibrate at one rate of speed, are responsible for the sounds? As an illustration, one hears a vocal solo and accompaniment at the same time. A. Your question about the reproduction of music by the talking machine would be unanswerable if it were true that a diaphragm could only vibrate at one rate of speed. The diaphragm of a piano, the sounding board, vibrates for all the sounds of all the notes and their harmonics. The same is true of the diaphragm of a violin, which is the wood of the back and belly. A plane piece of elastic material, such as in the diaphragm of the recorder and reproducer of a talking machine, has the ability, to vibrate in an indefinite number of modes at one and the same time, and the tracing by the needle point is a complicated one which represents all which you hear coming from the machine. 2. Why is it that the tea kettle full of boiling water may be taken from the fire, and sustained from below by the bare hand for several seconds, the bottom of the kettle feeling nearly ice cold to the touch? A. The ability to carry a kettle of boiling water upon the bare hand depends upon several facts. The kettle is no hotter than the water it contains. Any layer of soot which may be on the bottom of the kettle is a non-conductor of heat and protects the hand from the heat of the kettle. The moisture of the hand must first be evaporated before the hand will feel the heat of the kettle. The evaporation of the moisture of the hand causes the hand to feel cool, or as you state it, to feel that the kettle is cold. When all this is over it is time to set the kettle down, for then the metal will burn the hand.

NEW BOOKS, ETC.

THE IGNITION HAND-BOOK. By H. R. Van Deventer, E. E. Price, 50 cents.

Defective ignition is a great trouble maker. The first part of this tract is devoted to the various ignition systems and equipment, and the methods of installing and operating them. The features of the high and low tension systems, popularly known as the jump-spark and the make and break, are explained by text and illustration, and their respective adaptabilities, excellencies, and drawbacks are catalogued. The latter part of the treatise is given over to a particular type of magneto manufactured by a Southern firm.

THE STEEL WORKERS. By John A. Fitch. New York. Charities Publication Committee, 1910. 8vo., 240 pp.; illustrated. Price, postpaid, $1.71.

"The Steel Workers" gives us a series of vivid glimpses into the changing, roaring, seething inferno of the mill—glimpses that, like the impressions on a running cinematograph film, merge into one faithful picture of men eternally in action at hammer and furnace, at charging machine, stripper, and rolls. Sparks and vapors and molten iron create a background spectacular in the extreme, but the men who toil before this scenic display for twelve hours each day are conscious only of a stern, prosaic duty to be done in the face of ever-present danger, with a weary body at the day's end. "Homestead," Margaret Byington's contribution to the Pittsburgh Survey, took up the family side of the employee's existence. "The Steel Workers" shows us the man in relation to his work. Since the great strike of 1892, which resulted in victory for the employer, the subjugation of the employee has been complete, and men have been discharged for calling meetings to discuss the issues which Mr. Fitch handles in the present volume. As one old resident said, "If you want to talk in Homestead, you must talk to yourself." So Mr. Fitch takes up the cause of the man whose life is molded and fixed by the inexorable will of the steel kings, and leaves to others the interpretation of the steel industry from its administrative, commercial and technical sides.

METAL WORK AND ETCHING. By John D. Adams. Chicago: Popular Mechanics Company, 1911. 12mo.; 88 pp., illustrated. Price, 25 cents.

This is a handbook giving a list of the simple tools and materials, with concise directions as to their use in the fabrication of such novelties in metal as desk sets, candlesconces, hinges, photograph frames, and jewelry. The designs are in excellent taste, and open up a large field of artistic handiwork to those whose choice falls upon occupations and hobbies of this kind.

HEAT. By J. Gordon Ogden, Ph.D. Chicago: Popular Mechanics Company, 1911. 12mo., 119 pp. Price, 25 cents.

There are doubtless many who will welcome a short, popular exposition of high and low temperatures in their relations to applied mechanics and the phases of the subject which pass under examination are: Heat and its measurement; the production of low temperatures and their effects upon matter, the production of high temperatures and their uses in connection with the rare metals, the laws of expansion and contraction. There are also chapters on energy and fuels, artificial ice, and steam, boilers and engines.

THOUGHTS ON THE BOOK OF REVELATION. By Uriah Smith. Washington: Review & Herald Publishing Association. Price, 25 cents.

The expounder argues that the very name shows this to be a book of revelation and not a manuscript of concealed meanings. He endeavors to follow what is known as the literal system of interpretation, and to explain the figures, symbols, words and phrases in their commonest significance and attempting to show that history has responded to the voice of prophecy.

UNDER THE ROOF OF THE JUNGLE. A Book of Animal Life in the Guiana Wilds. By Charles Livingston Bull. Boston. L. C. Page & Co., 1911. 8vo.; 271 pp.; illustrated. Price, $2 net.

It is indeed an "amazing landscape" which is here unfolded before us in description and illustration, and the *dramatis personae* are no less remarkable and sensational than their background. Still, the Guiana jungles are places where the sensational becomes the commonplace. There are stories of jungle cats that play with rolled up armadillos as a kitten does with a ball; of troops of black spider monkeys, precipitating themselves from tree to tree in their terror-stricken flight from the jaguar of curious and deadly encounters in which birds, beasts and reptiles take part; of strange, loathsome little animals, of birds of ill-omen that follow a tapir calf for days, and of "green dragons" and "crested robbers" that lurk in foliage and prey upon the weak. Whether some of the situations into which the writer brings his animal actors are over drawn or not we can not say, but he has certainly succeeded in making real to his reader some of the glamor, some of the mystery, and some of the horror of the haunts he describes.

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Inquiry No. 9248. Wanted the address of parties to whom cocoanut fiber, either in the husk or after husking, is available as an article.

The Heavens in August

(Continued from page 104.)

the month, when he is farther north.

Venus is likewise evening star, but being farther from the sun than Mercury, and very much brighter, is a conspicuous object. She reaches her greatest brilliancy on the 10th, after which the rapid narrowing of her crescent, as she comes between us and the sun, more than makes up for the increase in her apparent size as she approaches us

At the beginning of the month she sets at 8.40 P. M., and on the 15th a little before 8 P. M. After this she approaches the sun very rapidly, and by the 31st she will be hard to see as she sets about 6.45.

At the beginning of the month she appears as a crescent some 35 seconds in diameter, and 12 seconds in width On the 31st her diameter has increased to 54 seconds, but her crescent is only 4 seconds wide, so that she sends us less light than before.

Mars is in Aries, and rises a little before 11 P. M on the 15th He moves slowly eastward, and increases in brightness and apparent size as the earth overtakes him.

Saturn is close by, but is moving more slowly, so that Mars overtakes him early on the morning of the 17th At this time the two planets are apparently separated by only 21 seconds—about ⅛ the moon's diameter. The moon herself is close by—about four degrees to the southward—and the triple conjunction will be a pretty spectacle in the morning sky

Jupiter is evening star in Virgo, setting about 10 P M. in the middle of the month Uranus is in Sagittarius just past opposition, his position on the 15th being R. A. 19 h 54 1 m, Dec., 21 deg 26 min Neptune is in Gemini, and rises about two hours before the sun

The moon is in her first quarter at 6 P M on the 1st, full at 10 P M on the 9th, in her last quarter at 7 A. M on the 17th, new at 11 P M. on the 23rd, and in the first quarter once more at 11 A M. on the 31st She is nearest us on the 21st, and farthest off on the 5th

As she passes round the skies, she comes into conjunction with Jupiter on the 1st, Uranus on the 8th, Mars and Saturn on the morning of the 17th, Neptune on the 21st, Venus and Mercury on the 25th, and Jupiter again on the 29th

KIESS'S COMET

A comet, visible in an opera-glass and possessing a tail, was discovered by Kiess at the Lick Observatory on July 6th

At that time it was in the southern part of Auriga, and rose about four hours before sunrise

The Original Paper Makers

(Continued from page 105.)

the main business of the nest. In the summer and autumnal months, they go forth by myriads into the neighboring country to collect provisions; and on their return to the common den, after reserving a sufficiency for the nutriment of the young brood, they divide the spoil with great impartiality; part being given to the females, part to the males and part to those workers that have been engaged in extending and fortifying the community. This division is voluntarily made without the slightest symptom of compulsion. Several wasps assemble round each of the returning workers and receive their respective portions. It is curious and interesting to observe their motions upon this occasion. As soon as a wasp that has been filling itself with the juice of fruits, arrives at the nest, it perches upon the top, and upon disgorging a drop of its saccharine fluid, is attended sometimes by two at once, who share the treasure. The first drop being thus distributed, a second and sometimes a third is produced, which falls to the lot of the others.

"Wasps do not as a rule store up honey, but it is found in the cells of some European species as well as in those of America.

"Another principal employment of the workers is enlarging and repairing the nest. They work with great celerity, and though a large number are occupied at the same time, there is not the slightest confusion. Each individual has its portion of work assigned to it, extending from an inch to an inch and a half, and is furnished with a ball of ligneous fiber scraped by its powerful jaws from posts, rails and the like The workers also clean the cells and prepare them to receive another egg, after the first has passed through all the stages of its life and is now a perfect insect working with the rest"

There is good reason for thinking that wasps have sentinels placed at the entrances of their nests, which, if you can seize and destroy, the remainder will not attack you This has been confirmed by the author and many other entomologists. If a nest of wasps be approached without alarming the inhabitants, and all communication be suddenly cut off between those out of the nest and those within it, no provocation will induce the former to defend it for themselves, but if one escapes from within, it comes with a very different temper and appears commissioned to avenge public wrongs In fact, very few incoming bees or wasps will attack the intruder Perhaps it is because the insect who is returning to the nest sees from afar all that is going on about its home, while the one coming from inside the nest is confronted suddenly by an unusual form when it reaches the usual point of exit It becomes alarmed, not only for itself, but for the safety of its colony What follows is only too well known to the student of social insects' When the workers make their rush they are prepared to sacrifice their lives in the execution of their orders

The first cold weather, after the queens have entered their winter quarters, produces an effect upon them similar to that which is produced upon the wood chuck and other animals subject to torpor At first a partial benumbment takes place, but the insect if touched is still capable of moving its organs As the cold increases all the animal functions cease The insect breathes no longer and has no need of a supply of air; its nutritive secretions cease, no more food is required, and it has all the external symptoms of death

Thus we will leave the few survivors of a once great insect empire, perhaps huddled behind the picture molding in our bedroom, insignificant now to be sure, but planning, nevertheless, in their insect minds every cell, every gallery, and every passage which is to be built when the new colonies are founded in the first warm days of April.

1912 Prospects for Automobile Industry

By Hugh Chalmers

WITH a great many of the standard cars for 1912 already announced, and with a new manufacturing season well under way, I have no hesitancy in predicting that 1912 will be a most prosperous year for the automobile industry

I do not say this as a mere matter of form, but because I really believe it Every large manufacturer of motor cars is vitally interested in the prospects for business I know of many men in the industry who, after careful investigation of conditions, have arrived at the same opinion as myself

In my opinion success in the automobile industry depends upon the solution of a manufacturing problem The days of rapid fire manufacturing and selling, of pyrotechnics and hail-fellow-well-met methods are past We all know that water will reach its level. It cannot flow up hill and it is bound to flow down as soon as some of it is drained away

The water has been drained out of the automobile industry

I believe there is a tremendous market both in the United States and abroad for American made automobiles. I consider this market will last not only this year and next year, but for many years to come Yet it is possible in any one season to flood this market. Over-production is the greatest danger to the automobile industry; or, at least, to those manufacturers who do not immediately realize that building and selling automobiles is a manufacturing proposition just like the building and selling of any other commodity.

There is a great market, for instance, for adding machines. Yet it would be



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We ask you earnestly to get acquainted with Sanatogen Investigate our claims first, if you like, and we are only too glad to have you do so. Ask your doctor about it, and in any case write at once for our book "Our Nerves of Tomorrow" the work of a physician-author, written in an absorbingly interesting style, beautifully illustrated and containing facts and information of vital interest to you This book also contains evidence of the value of Sanatogen which is as remarkable as it is conclusive

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The Bauer Chemical Company, Union Square, New York 515 EVERETT BLDG

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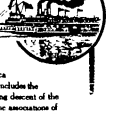
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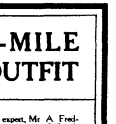


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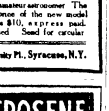
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ridiculous to think that manufacturers could build two or three hundred thousand adding machines every year and not flood the market

I think some manufacturers of automobiles have not yet come to a full realization of the fact that they can build too many cars. Those manufacturers, I surmise, are apt to find 1912 a very hard season before they are through with it There are some who may find themselves in serious difficulties in the next couple of years unless they plan more conservative operations than they have attempted in the past

Every manufacturer must realize that for every thousand of population there is only a certain percentage of men of enough means to buy motor cars The automobile manufacturer must consider his market The percentage of people of means in every community is almost as exactly as the mortality rates Only trouble can result from trying to go beyond the fact.

In my opinion the future of the automobile industry lies in the thoroughly standardized medium priced cars. The higher priced cars have a much more limited market than the medium priced cars They cannot be built in as large quantities, and yet, quite as elaborate manufacturing facilities are required for their production On the other hand, there are on the market at this time a number of medium priced cars which will give to the average buyer all the service he could purchase at any price For this class the future possibilities seem to me to be practically unlimited

I believe, too, that the market for the American medium priced car will extend to all of the automobile centers of Europe. There can be no question but that the American manufacturer is better equipped to build a good medium priced car than his European competitor

But the medium priced car which is to be a continued success must be well built, well finished and well equipped It must be able to compete with high priced cars, without discredit to its owner To this end all of the leading manufacturers are working

In this matter of greater automobile values one again has purely a manufacturing problem The high-grade, medium priced car of the future, I suppose, is going to be possible only in an economically conducted factory I believe this means eventually that nearly all standard manufacturers will be making most of their parts in their own shops

In the methods of manufacture, too, there have been opportunities for extravagance and waste which, unless eliminated, will create disastrous disproportion between price and value

I warrant that most of the recognized standard manufacturers have been giving the public more value each year for their money, and I believe that most of these standard manufacturers have now reached the point where they are making only a legitimate manufacturing profit, and in some cases are not making nearly as big a percentage as is considered perfectly legitimate in standard lines

I think that those manufacturers who build cars of high dollar for dollar value and at the same time refrain from overproduction, have nothing to fear from the future The automobile has taken a firm place in modern civilization The world cannot do without it now and will not do without it in the future The motor car is no longer a toy or a luxury; it is a necessity There will be a demand for automobiles just as there has always been a demand for horse-drawn vehicles, until something better than the automobile is devised to take its place. With this steady demand I see no reason why a conservative production of good cars at a fair price should not always bring success.

Numerous Gall-stones

THE French surgeon, A. Schachner, removed 14,000 gall-stones from one patient in one operation. Being greatly impressed by the large number, he sent out a questionaire to certain prominent surgeons, asking them to state their experiences as to this point His results are published in the *Gazette des Hôpitaux*; some of the figures are as follows: Mayo-Robson, often found over 500; at one time 1,058; 2,300. Moynihan, more than 3,000; 7,000 in one case. Mayo, 5,000-6,000. Eschner, 6,780. Deaver, 2,252. Dunlop, 2,011. Morgagni, 3,000. Hoffmann, 3,646. Langenbuch, 4,000. Nauhyn, 5,000. Otto, 7,082.

Gall-stones vary in weight from a few grains to about one ounce. When single, they are usually ovoid in shape, but when present in large numbers they are angular in outline Gall-stones are much more common in the gall-bladder than is generally supposed. There is hardly an autopsy on an elderly person that does not show from one to several. As long as they are in the gall-bladder they are quite harmless But when they start to go down the bile duct they are likely to cause serious trouble.

The Current Supplement

FEW of us realise how the science of geography has changed in recent years. A geographer nowadays is a man who studies environments, who examines the forms and qualities of the earth's surface, and who recognizes, defines, and classifies the different kinds of natural units into which it can be divided. His work consists in collecting new information, and in making use of the material thus collected. Mr. A. J. Herbertson, of the University of Oxford, sets all this forth in a highly instructive article in the current SUPPLEMENT, No. 1856.—That light actually exerted a pressure was first experimentally demonstrated by Peter Lebedew and by Professors Nichols and Hull In an article entitled "The Pressure of Light on Gases," Prof. Lebedew presents the results of an experimental application of the theory to comets' tails.—The planimeter is one of the most widely used of the measurement instruments employed by engineers. So few understand the principles on which the planimeter is based or the methods employed to determine if a particular instrument in use is giving correct results, that Mr W L. Durand's article on the subject will undoubtedly be welcomed.—Mr. Frederick C Coleman contributes an article on a wire rope tramway for German East Africa, which does some remarkable work in an inaccessable yet rich region of Africa.—Mr. Donald Murray, one of several inventors who have done their utmost to introduce the page printing telegraph, presents the first instalment of an elaborate treatise on "The Practical Aspects of Printing Telegraphy" in which he thoroughly discusses the type of machinery that must be employed and the commercial possibilities of that machinery.—Mr. S O Mast writes on the effect of light on the movement of the lower organisms. —The practical application of meteorology to aeronautics is considered by W. H. Dines.—Among the articles of minor interest may be mentioned those on the famous star No. 61 Cygni, "A Kerosene Oil Tractor for a Narrow-gage Native State Railway in India," "The Foundation Walls of the Giant Steamship Europa," "A New Registering Steam Meter," and "New Physical Apparatus."

American Phosphate

THE phosphate lands which a year or two ago were withdrawn from entry for settlement by the Federal Government, constitute, it is said, the greatest known phosphate deposit in the world. These lands comprise nearly the whole of Uinta County in Wyoming, and portions of Morgan, Rich and Oache counties in Utah, and of Bear Lake, Bannock, Bingham and Fremont counties in Idaho, making in all about 7,500 square miles of territory which is more or less underlain by phosphate rock. Besides these vast natural deposits, it is pointed out that the gases from the smelters at Butte and Anaconda, which are very injurious to vegetation, may be made to yield sulphuric acid for the manufacture of superphosphate fertilizers.

A Model Hydroplane

ON June 18th, 1911, Mr. Francis Lee Herreshoff and Dr. Carleton Dederer succeeded in making a hydroaeroplane model thirty inches long raise off the water with its own power in a distance of four feet and make a sustained flight for about 350 feet at a height of about 15 to 20 feet in Central Park, New York.



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Electricity

Turbine-driven Vessel With Electrical Speed Reduction.—Opportunity for comparing the performance of recent improvements in speed reducing gears with generator-motor systems of connection between steam turbines and propellers will be offered in the construction of two sister ship colliers now building for the United States Navy, as we read in the *Electrical World*. The new collier "Neptune" is to be equipped with Melville MacAlpine reducing gears, while the turbines of the new coal-carrier "Jupiter" will drive generators which in turn supply energy for operating the motors on the propeller shafts.

Power Brakes on New York Surface Lines.—The Public Service Commission has been considering the advisability of requiring all the surface railways of Greater New York to equip their cars with power brakes and folding steps. If this is carried out, says the *Electric Railway Journal*, it would mean the equipment of 3,630 cars, distributed among the following companies: Metropolitan Street Railway, 622, Second Avenue Railroad, 250, Brooklyn Rapid Transit, 1,807, Coney Island and Brooklyn Railroad, 459, Long Island Electric Railway, 16, New York City Interborough Company, 40, Richmond and Midland Companies (Staten Island), 20, Union Railway, 416. In 1910, 455 accidents were reported with double-truck cars equipped with hand brakes.

Terrestrial Magnetism.—The first mention of a magnetic pole is made by Girolamo Fracastro in 1538. Fifty-eight years later Livio Sanuto makes mention of two magnetic poles. The scientific development of the theory of terrestrial magnetism may be said to have taken its origin in the hands of William Gilbert (1600), who regarded the earth as a great magnet. This is the same Gilbert who first applied the term "electric forces" to the attraction and repulsion manifested by rubbed amber (Greek "elektron"). Certain variations of the magnetic declination were shown to have a period of twenty-six days by Broun (1861), and the significance of this observation was pointed out in 1887 by Adolf Schmidt, who drew attention to the parallelism between the period of declinations and that of sunspots.

The "Loading" of Telephone Circuits.—In an editorial comment upon the effects of the recent hot weather upon the telephone traffic, the *Electrical World* remarks: The recent hot wave, unprecedented in the records of the Weather Bureau for certain sections of the country, has had a remarkable effect in nearly doubling the normal volume of telephone traffic in some of the Eastern cities and towns. The regular telephone subscribers acted as though they could best keep cool by keeping the telephone switchboards hot. It is said that the modern telephone system has rendered possible the modern many-storied office building, by replacing the messengers that would otherwise overcrowd the elevators, so that the telephone is the reincarnation ghost of the displaced messenger boy. Now it may be said that the modern telephone system has substituted talking for walking in the hot wave intervals of the American summertime.

The History of the Oscillatory Discharge.—It is interesting to note the historical sequence of events leading up to the full understanding of the phenomenon of the oscillatory discharge, which is at the present day of such interest in connection with wireless telegraphy and the design of lightning conductors. The first observation having any bearing on the subject might be said to be that of the astronomer, Felix Savary, who in 1874 observed that the discharge from a Leyden jar would magnetize a needle sometimes in the one direction, sometimes in the opposite. This observation was repeated in 1842 by the great American physicist, Joseph Henry, who rightly attributed the effect to the oscillatory character of the discharge. The theory of the discharge from a condenser was worked out in 1853 and the succeeding years by William Thomson (Lord Kelvin), and Feddersen succeeded in 1858 in actually rendering visible to the eye the alternations in the spark discharge. This was accomplished by means of a rapidly revolving mirror.

Science

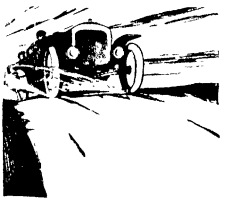
The Zodiacal Light.—The zodiacal light, the nature of which is still a mystery, sometimes presents very regular pulsations in intensity and form. In a recent note in the *Comptes Rendus*, Birkeland has stated that these pulsations correspond very closely with the periods found for regular magnetic waves in the polar regions, whence it is suggested that the zodiacal light may have an electrical origin. On the basis of several experiments Birkeland suggests that there may be a ring of luminous matter extending in the plane of the sun's magnetic equator.

White Water.—In a recent pilot chart of the British Meteorological Office many observations of the singular phenomenon called "white water" are collected. It is more frequently seen in the tropical parts of the Indian Ocean than anywhere else, and it impresses some observers as weird, ghastly and awe-inspiring. The ocean has a milky look and the ship seems to be passing through a kind of luminous fog, in which sea and sky appear joined and the sense of distance is lost. The phenomenon is believed to be due to some form of phosphorescence, but a satisfactory explanation of it is yet lacking.

Wonderful Wells of South Dakota.—East of the Missouri River in South Dakota, it is estimated, more than one thousand artesian wells now exist, drawing their water from the supply carried by the underlying sandstone formation, and supposed to come from the Black Hills and the Rocky Mountains. These wells, used mainly for irrigation purposes, are from 500 to 1,000 feet deep, and the pressure of water in the eastern part of the State is sufficient to give a surface flow, except on the highest lands. One well yields 3,292 gallons per minute, and furnishes power for a flour mill by day and for an electric light plant by night. The development of this source of water supply is still going forward.

Meteorological Wireless Telegraphy in Japan.—In the *Journal of the Meteorological Society of Japan* for May 1911, T. Saki writes of the use of wireless telegraphy in the Japanese weather service. The first wireless weather messages were sent for some time in 1906 between the temporarily established naval semaphore on Hachijojima and the Central Meteorological Observatory. The present system went into operation in May, 1910. All vessels passing within range of wireless communication with any coast station are requested to send a cipher report of meteorological observations taken at 6 A M., 2 P M., and 10 P M. to the Central Meteorological Observatory at Tokyo. If the weather is threatening additional observations are desired. In exchange, or this information the Observatory sends out wireless warnings to all vessels within range whenever a typhoon or dangerous cyclonic depression is reported, giving the position of the storm, barometric depth, and direction of movement. Reports are being received from a large number of vessels. Some of them come from as far east as the 180th meridian.

The New International Cloud Atlas.—Copies of the new edition of the International Cloud Atlas have been distributed. On the whole, this work is disappointing, as compared with the previous edition, published in 1896. The definitions of clouds have not been materially altered, except that *stratus* is now defined as "a uniform layer of cloud resembling a fog but not resting on the ground," in accordance with the decision of the International Meteorological Committee. Official status is given to the terms *cirrus uncinus* and *cirrocumulus*. English-speaking meteorologists will be astonished to learn, from this work, that the common English name of the *alto-cumulus* cloud is "great waves"! The earlier edition contained an "index of figures" in which was given the history, description and author of each of the paintings and photographs. This useful feature is unaccountably lacking in the new edition. Most of the colored plates of clouds are copied from the old edition, but are inferior in workmanship, on an average; and some of them are decidedly less characteristic pictures of the cloud-types depicted.



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¶ In every respect it is beautifully finished The upholstering is of good leather stuffed with hair All trimmings are of the finest materials available This new model from every possible comparative standpoint is the greatest value for the money that has ever been placed on the market

¶ People are apt to wonder why other manufacturers cannot equal this value It is for just this reason All manufacturing progress is due to better and larger manufacturing facilities the most efficient methods of handling men and the economical marketing of goods As any business increases its production costs decrease The larger a factory output becomes the better economical methods of manufacturing can be incorporated in the business

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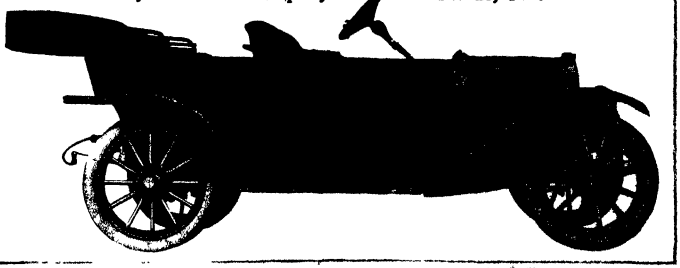
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Specifications

MODEL 59

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Horsepower—30
Clutch—Cone
Ignition—Two independent systems Splitdorf magneto and battery one set of plugs
Brakes—Internal expanding external contracting on rear wheels
Springs—Semi-elliptic front three-quarter elliptic rear 1¾ inch wide
Frame—Pressed steel
Steering Gear—Worm and segment adjustable 16-inch wheel
Front Axle—Drop forged I section
Rear Axle—Semi-floating
Wheels—Artillery wood 12 spokes wide hub flanges
Spokes—1½ inch spokes bolt for each spoke
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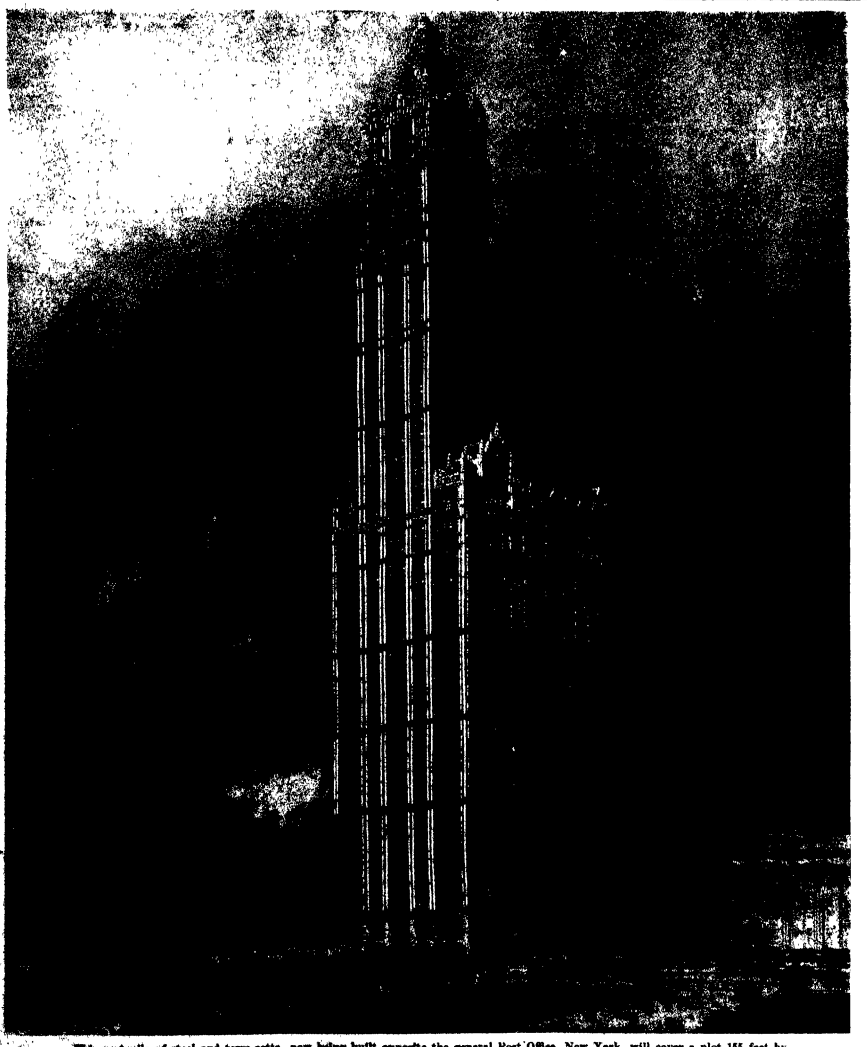


SCIENTIFIC AMERICAN

THE WEEKLY JOURNAL OF PRACTICAL INFORMATION

NEW YORK, AUGUST 5, 1911

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$3.00 A YEAR



This vast pile of steel and terra-cotta, now being built opposite the general Post Office, New York, will cover a plot 155 feet by 200 feet. Its topmost point will be 775 feet above the sidewalk.

THE TALLEST OF TALL BUILDINGS.—[See page 119.]

SCIENTIFIC AMERICAN

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The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are clear, the article good, and the facts authentic, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

The purpose of this journal is to record accurately and in simple terms, the world's progress in scientific knowledge and industrial achievement. It seeks to present this information in a form so readable and readily understood, as to set forth and emphasize the inherent charm and fascination of science

The Coroner on the Bridgeport Railroad Wreck

As the result of his investigation of the recent wreck of an express train at Bridgeport, the coroner finds the New Haven Railroad guilty of "criminal negligence" in providing an unsuitable cross-over between the express and local tracks at the point where the disaster occurred. Although we agree with this finding so far as it attributes the wreck largely to the existence of a short cross-over, an opinion which is entirely in accord with our editorial on this subject in our issue of July 22nd, it is pushing the matter too far to designate the practice of the company as criminal.

Criminal negligence can be charged against a company only when it neglects to follow provisions for safe operation which have been established by law, or when it falls below the practice which has come to be regarded among the railroads as sufficient for safe operation. Judged by either of these tests, the New Haven cannot be held blameworthy. The use of short cross-overs between express and local tracks, or in locations where express trains running at full speed have to be switched from one track to another, is unfortunately very general in railroad practice. A few of the best roads, it is true, are alive to the danger; and, as we pointed out in the article referred to, one at least of them is revising its tracks by eliminating short cross-overs on main four-track roads when fast express trains may have occasion to cross from one track to another, but these are the exceptions and not the rule.

On the other point raised by the coroner, that it is inexpedient to use short cross-overs on lines over which express trains run, the coroner is entirely correct. The danger of a wreck through failure of the human element is so imminent, that we think the subject demands the immediate attention of the Interstate Commerce Commission, and the passage of a law requiring that such cross-overs be made of a proper length and the curvature of the turn-outs be made so easy that expresses can take them at high speed without danger of derailment. Although the cost of making these changes would be considerable, it would be well repaid by the greater safety which would be secured. Certainly, in cases like the Bridgeport wreck, where the cost of damages will prove to be enormous, the investment would prove to be good economy.

Solving Labor Questions in the Laboratory

AMONG the many methods proposed for the solution of difficulties between the employer and the workman, surely the most original is that suggested by Dr A Imbert, who, in a recent paper published in the *Revue Générale des Sciences*, proposes to apply laboratory methods to the solution of the wage problem. The author believes that physiology can furnish us with some precise information on the question of the ratio equivalence between work and pay.

Proceeding on the proposition that, in the work of a human or animal machine, the energy expended is produced by an increase in food above the amount which the organism requires when at rest, he makes the statement that the proper remuneration for work can be exactly determined, and this for the reason that it should correspond exactly to the cost of the extra food which made the work necessary.

The author considers the case of a postman who travels daily 35 kilometers on a bicycle in a level country, and who kept a record of the quantity and quality of the food which he consumed during a fortnight, the calorific value of which per day was calculated to be 3,200 calories. The day's work was estimated to be 140,000 kilogram-meters, corresponding to 330 calories of heat. Assuming a value of one-third for the efficiency of the human motor, Dr. Imbert determined that the postman's daily work required the combustion of an amount of food capable of furnishing 990 calories—an estimate which agrees very closely with one based on numerous physiological experiments showing that the human organism at rest requires daily on an average a quantity of food capable of furnishing about 2,300 calories. Now the difference between that and the 3,200 calories representing the value of his daily food as recorded by the postman gives a difference of 900 calories, which agrees fairly well with the 990 calories obtained by the first method of calculation. The mean equivalent may be taken as 945 calories.

The postman found that the cost of his food was 85 centimes a day, and from this it follows that the cost of his work was 25 centimes a day, instead of the four francs which he actually receives. It is evident that his pay should be based on something more than the monetary equivalent of the work done; the most selfish employer would concede that the pay should cover at least the 2,300 calories of food required by the man at rest, in addition to the 945 expended in work. Furthermore, he needs in addition to food, shelter and clothing, so that he should receive an additional allowance to pay for food, rent and clothing, items which are inseparable from any estimate of wages, even when they are considerd exclusively as remuneration for work done. The pay should provide for the support of the workman's family. Therefore, physiologically considered, the system of payment based on the monetary equivalent of the increase of food required is certainly inadequate, and the pay should be based upon an intelligent consideration of the general circumstances of the workman's life and surroundings and his reasonable expectation of comfort, recreation, family life and provision for old age.

A more direct application of laboratory methods was that made in the south of France, where hundreds of women are employed with pruning shears in cutting up long American vine shoots into cuttings suitable for planting. It is a mechanical operation, capable of exact measurements. By applying to the shears a simple dynamometer in the shape of a rubber bulb, Dr. Imbert measured the work done, by means of the travel of the fingers and the pressure exerted, the latter being recorded on a moving strip of paper. The cuttings are classed as large or small, according as their diameter is greater or less than six millimeters, and the pay is 60 centimes per thousand for the large cuttings and 50 centimes for the small ones. The women asserted that the difference of ten centimes was not sufficient, and they obtained an increase of pay.

From the paper tracings, Dr. Imbert found that for each centime of pay the worker exerted a total effort of 110 kilogrammes in cutting the small stems at 50 centimes per thousand, and a total effort of 266 kilogrammes per centime in cutting the large stems at 60 centimes per thousand. It was evident from these figures that the pay was not proportional to the work, and the experiments furnished an incontestable proof of the justice of the women's demands. For if fifty centimes was paid for the small cuttings, the pay for the large ones should have been 140 centimes instead of 60 per thousand.

Dr. Imbert claims that his system can be applied to a wide range of manual work, where the multiplicity of mechanical actions would seem to present an obstacle to experimental study of this kind. For instance, he used it successfully to determine the actual work accomplished in moving bags and bales with a hand-truck. The correctness of his conclusions would seem to be borne out by a comparison of the same work when it was done first with a truck and alternately then with a wheelbarrow, the wheelbarrow proving, of course, to be the more fatiguing medium. The article of Dr. Imbert which is published in full in the current issue of the SUPPLEMENT, will be found to repay a careful study.

Amazing Progress in Aviation

FOR the third time within the past three months a French naval lieutenant, who learned to fly only the first of the year, has won a long-distance cross-country race and demonstrated his prowess in airmanship. We refer to Lieut. Conneau, who, flying under the name of André Beaumont, has met with wonderful success in aviation. In the Paris-Madrid, Paris-Rome, the European circuit, and, lastly, the *London Daily Mail's* Circuit of Great Britain, Lieut. Conneau, flying a Blériot monoplane, has been among the leaders. In all but the first-mentioned race he has succeeded in finishing the winner.

All of these races have been from 900 to more than 1,000 miles in length, but the English circuit was the most difficult on account of the rule requiring the aviator to finish the race with the same aeroplane and motor with which he started and without the replacement of any of the essential parts. Three French monoplanes, piloted by two Frenchmen (Lieut. Conneau and Jules Vedrines) and one Englishman (Mr. Valentine) led the race from the start. Valentine was forced out after a gallant struggle and after he had completed half of the circuit, on account of a broken propeller; but his two competitors, because of their experience and training, finished the race without mishap and in record time. When the rules of this race were formulated it was believed that ten days would not be too long a time to allow for the completion of the circuit, yet despite the enforced rest made necessary by the rules, Lieut. Conneau and M. Vedrines completed the course in 3¼ 1-2 hours and 35 5-4 hours, respectively, and finished a week ahead of the time limit which had been set for the completion of the race. The actual time in flight of the French lieutenant was 22 hours and 28 minutes, corresponding to an average speed of 45 miles an hour, while Vedrines required an hour and 16 minutes longer, which reduced his speed to 42.8 miles an hour. The speed averaged by the winner in this race was about the same as the speed he made in the European circuit. The remarkable feature of the race was the fact that it was completed without mishaps or breakage of the machines, and distances as great as from New York to Montreal were covered at a 60-mile clip. The present race was for the aeroplane very similar to the "sealed bonnet" contests that were in vogue a few years ago for automobiles. It is interesting to note that a prize of $30,000 for the first aviator who should fly from New York to St. Louis—a distance of about 1,000 miles—even with a time limit of 100 hours, did not interest any aviators, American or foreign, when it was offered a year ago. It is doubtful even now whether this prize would attract any foreign aviator should it be put up for competition again. What is needed in America is a prize of $50,000 to $75,000 for a circuit race of 1,200 to 1,500 miles. If the Aero Club of America could organize such a race, it would show itself worthy of being the representative organization, and would encourage a development of aviation in a way that has never yet been done in this country.

Next to endurance in cross-country flying, the endurance of man and machine in a single flight is one of the most interesting questions. At the end of last year, Henry Farman attempted to remain aloft in continuous flight for a period of 12 hours. He actually succeeded in flying continuously for 8 hours and 12 minutes. Since then he has always been eager to increase his record to the half-day point. On July 21st, M. Loriden, in one of his machines, managed to fly continuously for 11¼ hours, during which time he covered a distance of 469 miles. It is claimed that he alighted on account of fatigue and not because his fuel was used up. On July 26th, at Mineola, St. Croix Johnstone, in a Moisant monoplane, made 39 circuits of a 5-mile course, covering 195 miles in 4 hours, 1 minute, 54 3-5 seconds, in an effort to break M. Loriden's record. He was obliged to descend on account of motor trouble, but he raised Parmalee's endurance record, made last January at Los Angeles, by 22 odd minutes.

The above achievements show the wonderful strides that are being made week by week in aviation and lead us to believe that within a very few years we shall have trans-continental and trans-Atlantic aeroplanes flying at faster speeds than the modern express trains.

Even at the present time express-train speed has been greatly exceeded. In the English circuit Lieut. Conneau flew the 348 miles from London to Edinburgh at sixty miles an hour and beat by a whole hour the fast "Flying Scotsman" express, while in the Paris-Madrid race Vedrines covered the 830 miles between Paris and Angouleme at the rate of 72

Eighty Years of Locomotive Practice in England

How the Old "Rocket" Compares with a Modern Engine

IN the accompanying illustration an interesting impression is conveyed of the development of the railway locomotive in Great Britain during a period of eighty years. Stephenson's famous "Rocket" is here shown in comparison with the latest type of London and Northwestern Railway passenger express traffic locomotive, "W. C. Brocklehurst, No. 2155," of the new "George the Fifth" class, and their juxtaposition affords a comprehensive idea of the remarkable strides that have been made in railway engineering upon British railways. The "Rocket" was built in 1829, and took part in the famous contest at Rainhill, when the directors of the Liverpool and Manchester Railway, now forming part of the London and Northwestern system, offered a prize of $2,500 for the purpose of deciding the question of the adaptability of steam locomotives for working railways. Five engines were entered in that classic competition, from which the "Rocket," as is well known, emerged victorious.

It is interesting to compare the weight and speed of the train in this competition, which may be regarded as the standard for those early days, with those of modern times. It was stipulated in the 1829 competition that the successful engine, if it weighed 6 tons, should be capable of drawing after it, on a level plane, a train of the gross weight of 20 tons, including tender and water tank, at the rate of 10 miles an hour, while the steam pressure in the boiler was not to exceed 50 pounds per square inch. In the actual trial the "Rocket" attained an average speed of about 19 miles per hour while hauling a train weighing 13 tons.

Stephenson's engine had a cylindrical boiler measuring 6 feet in length by 3 feet in diameter, with flat ends, having 25 copper tubes of 3 inches diameter. The firebox was 2 feet wide and 3 feet high. The cylinders, two in number, were 8 inches in diameter, and had a stroke of 16½ inches, while the diameter of the driving wheel was 56½ inches. The engine exerted about 20 horse-power, and weighed 9,296 pounds, while the tender weighed about 7,168 pounds. The latest London and Northwestern engine standing alongside is one of the latest types of express engines used in this company's express traffic. The two inside cylinders are each 20½ inches in diameter, and have a stroke of 26 inches, with a boiler pressure of 176 pounds per square inch, or three and a half times that allowed in the "Rocket." The boiler is 62 inches in diameter, with a barrel 141¾ inches long, fitted with a steam superheating arrangement by means of which the temperature of the steam is raised to 650 deg. F. before being used in the cylinders. The firebox is 7 feet 4 inches long by 4 feet 1 inch wide outside the casing. The coupled driving wheels are 81 inches in diameter, while the weight of the engine in working order is 133,064 pounds, and that of the tender 86,920 pounds, giving a total weight of 219,984 pounds. It is fitted with apparatus for picking up water from troughs while traveling at full speed, and has a tank capacity of 3,000 gallons, while it carries 7 tons of coal.

In order to test the power and capability of this type of engine, the first locomotive built, the "George the Fifth," made an experimental run between Crewe and Euston, 158 miles, with a train composed of a dynamometer car and 13 8-wheeled corridor coaches weighing 357½ tons, and with engine and tender weighing 454¼ tons. On the outward journey one stop was made at Rugby, the average speed between these points being 54 miles per hour, the highest speed recorded being 68 miles per hour. Between Rugby and Euston the average speed was 58¼ miles per hour, with a maximum of 73 miles per hour. The return journey from Euston to Crewe was made without a stop, which distance was covered from station to station in 2 hours 36½ minutes, giving an average speed of 60½ miles per hour, with a maximum speed of 78½ miles per hour. These speeds and weights compared with what the "Rocket" achieved illustrate strikingly the enormous progress made in one branch of railway engineering, and show the great facilities placed before the public for rapid transit from one point to another in these days as compared with the condition in the early days of British railways.



Stephenson's "Rocket," and the latest type of English locomotive (George the Fifth type).

A STUDY IN LOCOMOTIVE EVOLUTION

The Comets

DR. WILLIAM R. BROOKS, director of the Smith Observatory, and professor of astronomy at Hobart College, Geneva, N. Y., discovered another comet on the night of July 20th. Its position was right ascension 22 hours 18 minutes 40 seconds; declination north 20 degrees 57 minutes. The comet is in the constellation Pegasus, and is moving slowly in a northwesterly direction.

While not at present visible to the naked eye, it is a fairly bright telescopic comet, and its movements will be observed with interest. This is the twenty-sixth comet discovered by Prof. Brooks—a larger number than any other living astronomer has found.

The Kiess Comet.

A comet was discovered by Kiess at the Lick Observatory on July 6th in R. A. 4 h. 51 m. 51.8 s.; Dec. north 20 deg. 18 m.

An observation of this comet was obtained by Dr William R. Brooks at the Smith Observatory, Geneva, N. Y., on the morning of July 13th, in R. A. 4 h. 40 m., Dec. north 24 deg. 10 m., which shows the motion of the comet to be southwest. It is in the constellation Auriga, and on the last named date about 11 degrees south of Capella.

It is now a bright telescopic comet and has a visible tail.

Artificial Measles in Monkeys

MANY attempts have been made to cultivate the specific organism related to the cause of measles in the blood of such animals as are commonly used for experiments on serums and toxins, etc., but without success. About seven years ago an English experimenter tried in various ways to infect chimpanzees by injection of blood taken from a measles patient but got only negative results.

Within the last year Dr. John F. Anderson, Director of the Hygienic Laboratory, and Dr. Joseph Goldberger have carried on similar experiments with a number of rhesus monkeys. The blood used was drawn from measles patients. The monkeys showed rises in temperatures characteristic for this disease, and in a number of cases there were distinct eruptions on various parts of the skin. Two of the monkeys that showed distinct symptoms were held for the purpose of inoculating other monkeys, two new ones being inoculated from each. After a number of days, each of the monkeys showed definite reaction in temperature, one in each pair also showing an eruption of the skin. From these experiments it may be hoped that further research in the attempt to obtain anti-toxic sera for measles, or at any rate further light upon the nature of the disease, will be more profitable for treating the malady, than those of the past.

The "Electric Arc"

A Pioneer Electrically-propelled Ship

By the English Correspondent of the Scientific American

FOR some two or three years past there has been considerable academic discussion regarding the possibilities of propelling large vessels by an electrical system. Two Scottish electrical engineers, Messrs. Mavor and Coulson of Glasgow, who have devoted considerable attention to this problem, have carried theory to a practical stage, a special vessel having been built by the Dumbarton shipbuilding firm of MacLaren Brothers and equipped with the electric propulsion set which they have evolved for use with alternating current. Through the courtesy of the inventors we are enabled to describe the features and illustrate this interesting craft.

The vessel measures 50 feet between perpendiculars, has a beam of 12 feet, molded depth of 7 feet 4 inches; a maximum draft of 4½ feet, and is certified by the Board of Trade to carry fifty passengers. It has been christened appropriately the "Electric Arc."

The mechanical equipment is carried out on the lines set out by Mr. Mavor in his paper, read before the Institution of Engineers and Shipbuilders in Scotland in February, 1908, and before the Institution of Civil Engineers in December, 1909. It comprises a six-cylinder Wolseley gasoline motor developing 45 brake horse-power, driving an alternating current dynamo with its exciter, the propeller being coupled to an alternating current motor. The switch gear is operated from the deck, or from the engine room, as desired.

The inventors point out that although electric propulsion is not necessary or suitable for all vessels, yet in many cases it will form a convenient and economical addition to the power equipment of a ship. Hitherto electric transmission for marine propelling purposes has always been carried out upon the continuous current principle, but while this method is very convenient and suitable for small powers, its utilization offers serious difficulties in large installations. The inventors therefore maintain that alternating current motors alone are suited for the transmission of high powers at sea. They accordingly evolved their own lines upon which such should be applied, and the present large size model for actual practical experiments was constructed to demonstrate the possibilities and advantages of the system in regard to large vessels, and also to gain experience in details of application and handling of this equipment.

The motor has no brushes or slip-rings. It is of the type known as the "multiple wound machine," in which there are in the present instance two independent windings. The current used is alternating three-phase. The generator is designed to give two power-circuits to the motor, to represent the condition which would obtain more usually when larger powers were involved and where two or more generators would be in use for the full power.

The first combination of generator and motor windings gives full speed of 7.25 knots, and the second combination about two-thirds of full speed—about 5 knots. The power applied to the propeller is determined by the electric control, which in the present case is put in the hands of the navigator and operated from the bridge.

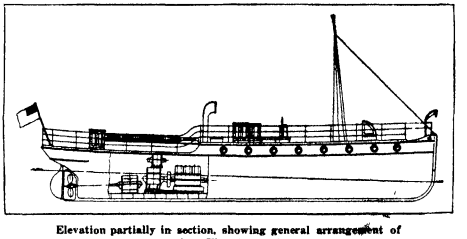
The first trials with the "Electric Arc" proved eminently successful. It was run over the measured mile in the Gareloch, the tests comprising the stopping, starting, speed-changing, reversing and maneuvering qualities of the vessel. The mean speed attained was 7.25 knots, with the propeller making 415 revolutions per minute. The current readings showed that about 25 brake horse-power was delivered to the propeller shaft at full speed, and that 35 brake horse-power was developed by the engine running rather below the rated speed.

The maneuvering capabilities of the boat were very strongly emphasized, the propeller being reversed from ahead to astern and *vice versa* time after time.

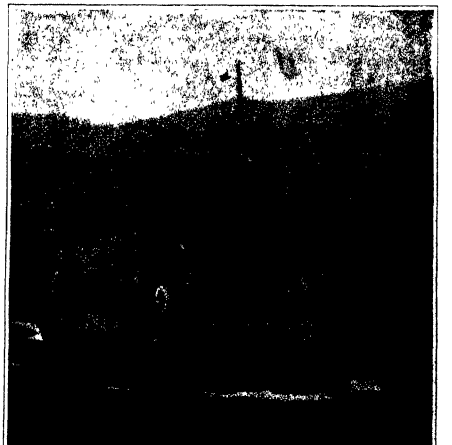
The reversing operations were equally striking, it being shown possible to throw the switch from "full speed ahead" to "full speed astern," *or vice versa*, without running any risk of damaging the machinery. Though such a sudden change would not be required in actual practice, it offered a severe test of the capabilities of the electrical system. The experiments are to be continued, and the success achieved so far has resulted in greater interest being centered in the possibility of adapting electrical propulsion to large vessels.



The engine and dynamo room of the "Electric Arc."



Elevation partially in section, showing general arrangement of the "Electric Arc."



The "Electric Arc" under way.

A BOAT PROPELLED BY ELECTRICITY

Fish Pastes Abroad

EXPERTS in the United States are giving careful study to the methods in vogue in certain fish factories in northern Europe, with a view to the economical preparation of products from fish that hitherto Americans have regarded as useless.

Among these is the preparation of fish-pastes from fish that have no commercial value either as fresh or salted food, but which, at the same time, possess a high nutritive value. It is said that the flesh of both the shark and the whale (which latter, however, cannot, of course, be properly classified as a fish) are largely utilized for the preparation of a fish-extract that resembles in some respects the popular extracts of beef, being at the same time far cheaper. All fishy flavor is eliminated by chemical processes, and the extract is valuable for the foundation of soups and in general cookery.

While meat is very nutritious, but its excessive amount of fat renders it unpalatable to most persons. To this fat is removed before the extract is boiled down to a syrupy consistence and sealed in jars.

In many of the fish factories of Norway a "fish-meal" is made that is eaten extensively by the nations of northern Europe. In these several ways fish which were formerly rejected as being unfit for food are being utilized to the advantage of many.

Trees and Men

IT has been calculated that a single tree is able through its leaves to purify the air from the carbonic acid arising from the perspiration of a considerable number of men, perhaps a dozen or even more.

The volume of carbonic acid exhaled by a human being in the course of twenty-four hours is put at about 100 gallons; but by Boussingault's estimate, a single square yard of leaf-surface, counting both the upper and the under sides of the leaves, can, under favorable circumstances, decompose at least a gallon of carbonic acid in a day. One hundred square yards of leaf-surface then would suffice to keep the air pure for one man, but the leaves of a tree of moderate size present a surface of many hundred square yards.

The Aviation Motor

Recent Developments in France

By Earle L. Ovington, Licensed Aviator

EMPLOYING the broadest possible classification, the science of aviation may be divided into two epochs—before man flew and afterward. The former might be called the Experimental Period and the latter the Practical Period. To be sure, at present there seems to be considerable discussion as to the exact line of demarkation separating these periods, but this resolves itself largely into a definition of the word "fly," as applied to the particular subject in hand. Lilienthal and other early experimenters with gliding machines undoubtedly imitated nature more closely than many later workers who used power-driven aeroplanes; but remarkable as were many of these early experiments, they did but pave the way for real man-flight, which may be considered to have been accomplished only when man left the ground with a power-driven sustaining surface, under more or less stable conditions. The object of the discussion which is raging so fiercely throughout the world of aviation at the present time is to ascertain who was the first to fly in a power-driven aeroplane, with the machine under the control of the operator, particularly as applied to lateral stability.

Any one who has given the subject even casual examination cannot but be impressed by the remarkable similarity of some of the more advanced machines of the Experimental Period as compared with many of the successful fliers of the Practical Period. Indeed, this similarity is so marked that the enthusiast seeks further for the cause, and has not gone far before he realizes that the development of the light and efficient internal combustion motor has done more than anything else to lift aviation from the experimental stage to that of practical man-flight.

In the automobile field we find a parallel state of affairs. Clumsy self-propelled steam vehicles existed years before the brilliant inventions of De Dion and Daimler gave to the world the wonderfully light and comparatively simple prime mover which has made the automobile the universally successful vehicle it is to-day. It is the same with the aeroplane. Examine Langley's man-carrying machine, which unfortunately was never properly tested, and the large, ingeniously constructed aeroplane of Sir Hiram Maxim, not to mention other models of early experimenters, and one is impressed by the enormous handicap they labored under in not having a simple, light motor.

In the early development of the aviation motor, extreme lightness was the object sought for, and was at first obtained only at an entirely disproportionate sacrifice of efficiency and reliability. Fortunately for aviation, however, the development of a suitable motor did not have to start from the heavy, stationary gas engines, for at the dawn of the Practical Period in aviation the automobile engine had already reached a comparatively high state of perfection. Designers of aviation motors at first simply took the more advanced types of automobile motors, and, adhering to their general design, eliminated weight by reducing the factor of safety of each member to the lowest practical point, and by employing the very highest grade of material and workmanship. The Antoinette motor which proved so successful in racing motor boats and the early aeroplanes, is a sample of this type. And it speaks well for Monsieur Levavasseur, the designer and constructor of this motor, that even to-day, in spite of the fact that the latest type of motor differs little from the earlier models, the Antoinette engine is considered in the foremost class among aviation motors.

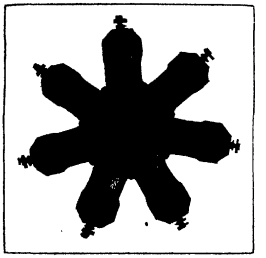


Fig. 1.—The new 70-horse-power Gnome motor.

At the present time, extreme lightness for a given output is as much sought for in aviation motors as it was in the first stages of development of the practical aeroplane. But this is due largely to the fact that an artificial state of affairs exists in the development of the aeroplane by the world's greatest designers and builders. During the Experimental Period of aviation, man was satisfied to progress slowly and along rational lines. Theory was far in advance of practice. During this period Langley, Lanchester and Maxim gave to the science of aviation their unparalleled researches, not to mention the works of less known writers. But from the moment man really flew, Practice vanquished Theory, and designers proceeded along almost entirely empirical lines to develop a flying machine for exhibition and racing purposes. From the opening of the Practical Period to the present time designers have been too busy actually building machines to meet the comparatively enormous demand, to worry very much about the theoretical side of the subject. Very great progress has been made, to be sure, but it has been largely confined to making the machines stronger and faster, and in standardizing, to a certain extent, the several types.

The demand for a light aeroplane for exhibition purposes, and a fast one for racing, has forced the designers of aviation motors to tax their inventive capacities to the utmost in an effort to produce a motor of the greatest possible power for a given weight. And when it is considered that there now exists a motor which weighs only about three pounds per horse-power, which has run continuously over eight hours in actual flight, we can get an idea of the wonderful strides made in the development of the aviation engine.

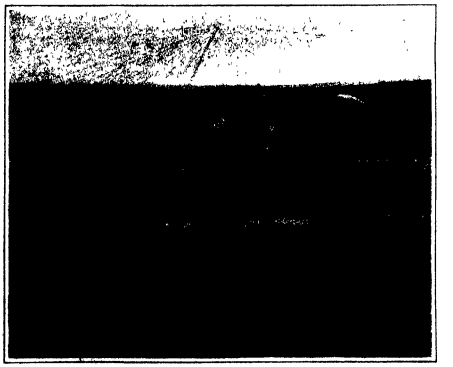


Fig. 2.—Bleriot 1911 model fitted with the 70-horse-power Gnome motor.

Although to-day lightness and speed seem to be the greatest aims of the designer, the time is not far distant when extreme reliability and high efficiency will be the objects sought for. By its very nature an aeroplane remains in the air only so long as it is moving rapidly forward, and a properly working motor is necessary for this condition, hence reliability without any question whatever, is the first essential in an aviation engine, assuming, of course, that the motor is light enough for the purpose. Duplicate power plants, or possibly a smaller power plant for emergency use, will do much to add to the security of aerial travel, but even under such circumstances the motive power should be as reliable as it is possible to make it. And as we understand more fully the design of the supporting surfaces in an aeroplane and the engineers more fully appreciate the desirability of reducing head resistance to a minimum, great power in a light

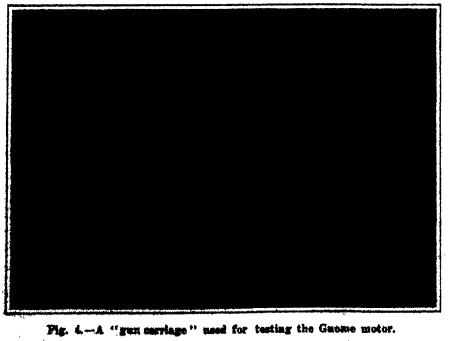


Fig. 4.—A "gun carriage" used for testing the Gnome motor.

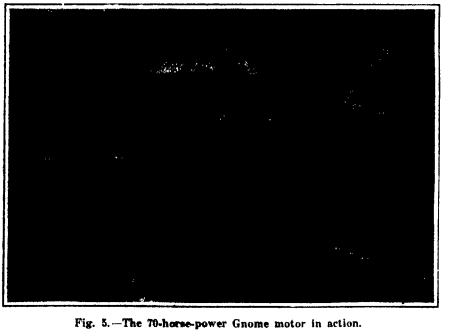


Fig. 5.—The 70-horse-power Gnome motor in action.

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weight will become of less and less importance The designer of the little Nieuport monoplane made giant strides in this direction when he produced a machine carefully calculated to reduce head resistance This machine although fitted with only a 30-horse-power motor, almost equaled the speed record made by Leblanc at Belmont Park with his fourteen-cylinder, 100-horse power, Gnome-driven Blériot

Birds sent for hours under propitious circumstances with practically no expenditure of energy, and even under very adverse conditions fly with an efficiency which should make the intelligent aeroplane designer drop from his self-erected pinnacle as "conqueror of the air, and realize how poor indeed, from the standpoint of the natural fliers, is his flying machine

Aviation motors may be broadly divided into two general classes—reciprocating and rotary motors In the former the cylinders and crank case remain stationary while the crank shaft rotates, and in the latter type the crank shaft is stationary while the crank case and cylinders revolve around it All automobile engines and most aero motors, are in the reciprocating class, while the Gnome is by far the most prominent engine in the rotary class

It is interesting to note the various and often ingenious expedients adopted by the leading manufacturers to attain the same end, i e, the production of a light motor The designer of the Anzani reciprocating engine, who was one of the very first to devote his time to the production of a practical aviation motor, developed his product from the power plants he used on his motorcycle pacing machines His first engine was a three-cylinder one, having the cylinders all in one plane and arranged radially around the crank case By this arrangement he was able to use a crank case for three cylinders which was only slightly larger than that for one With this motor, rated at 25 horse-power, Blériot first crossed the English Channel, and in spite of the remarkable strides which have been made in more powerful aero motors, this original type of Anzani, almost unchanged, is to-day one of the most reliable engines made, and is the one used by Blériot and other leading manufacturers in their aeroplanes made for school purposes The writer, who obtained his French *brevet de pilote-aviateur* at Blériot's school at Pau, France, was surprised at the enormous amount of abuse these little motors stood without *materially* losing their power Anzani's latest product is a six cylinder, star-shaped motor of the same type, which somewhat resembles in appearance, when stationary, the rotating motor so much used in French aeroplanes

The R E P reciprocating engine, the product of Robert Esnault-Pelterie is another motor of this class where the cylinders are arranged radially around a common crank case The designer has carried this principle very much further, however, than any one else, for the writer saw last February, at the factory near Paris, a new R E P engine having no less than ten cylinders

In the Antoinette engine the factor of safety has been reduced to a minimum and made as uniform as possible for the component parts, by the use of the very highest class of material and workmanship Every little detail has received the attention of its experienced designer, Monsieur Levavasseur and most ingenious are some of the structural details The flywheel for instance which ordinarily is by far the heaviest member of an engine, in the Antoinette is simply a steel rim connected to a central hub by a flange of very thin and flexible steel When the motor is building up its speed, this flange is so flexible the whole flywheel seems "out of true" but at normal engine speeds centrifugal force is sufficiently strong to make the flywheel as rigid as if it were the usual heavy cast affair. In the Antoinette flywheel almost every ounce of weight is where its effect is greatest—in the periphery Other equally novel artifices are employed in order to reduce weight

Among American engines of the reciprocating class the Curtiss is probably the best known and most widely used Curtiss, like the designer of the Antoinette, has carefully studied every part of his design and produced a motor remarkably light and efficient It was with this motor in his own aeroplane that Curtiss won the first Gordon Bennett race at Rheims, France, in 1909, triumphing over the best European productions.

The question has yet to be definitely settled among designers of reciprocating engines as to whether cooling by air or water is the most desirable for aero engines Of the engines mentioned, the Antoinette and Curtiss use water cooling, while the Anzani and R E P depend upon air It is perhaps significant to note, in this connection, that the Renault motor is air cooled, while the famous automobile engine, made by the same concern, is cooled by water circulation Simplicity being such a desirable point where reliability is sought for, and reliability being such an essential in the aviation motor, the writer strongly favors the air-cooled motor, even for engines of the reciprocating class.

We now come to the consideration of what is undoubtedly the most interesting and promising type of internal combustion motor to-day—the rotary engine The designers of this comparative newcomer made a giant stride into the unknown when they entirely

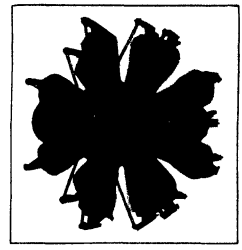


Fig. 6.—The 100-horse-power fourteen-cylinder Gnome, as used by Leblanc and Hamel in the recent International Cup race.

A 7-cylinder, 70-H P. engine on a Nieuport monoplane won the race

reversed the operation of the component parts of the gasoline engine Incidentally, in doing so, they banished forever certain inherent difficulties found with motors of the reciprocating class

In the ordinary reciprocating motor, the cylinders, whether air or water cooled, are stationary, as is the crank case, while the crank shaft revolves In the rotary motor, the crank shaft is the stationary member, while the cylinders, arranged radially and air cooled, rotate with the crank case around it. As there is to-day only one representative of the rotary class, which has universally proved its right to be classed as unquestionably reliable, we will confine our remarks to that particular make—the wonderful Gnome rotary motor

Fig 1 is the very latest product of the Gnome factory—the new 70 horse-power. Fig 2 shows the writer's 1911 model Blériot, fitted with this motor, it being the first machine sent out from the Blériot factory employing the motor of 70 horse-power, and the first Blériot with the new "inverse curve" tail brought to America Comparing the 50-horse-power and the 70-horse-power engines, the method of attaching the cylinders to the crank case has been greatly improved. In the case of the 50 horse-power it requires a mechanic of the highest order, who knows the Gnome motor thoroughly, to dismount and assemble it, but with the new 70 horse-power it is necessary only to unscrew a few nuts when the front half of the crank case may be removed, leaving the cylinders readily detachable. The method of clamping the cylinders, too, is far more secure than in the older model.

The writer spent a most interesting afternoon going over the Gnome factory, which is just outside of Paris, with Monsieur Seguin, the chief engineer. This factory is literally engaged in turning out steel shavings, for every part of the entire motor is turned from the solid metal. In the rough the cylinders are drop-forged nickel-steel bars; but when the lathes and boring tools have completed their work, they are engine cylinders with radiating fins as thin as paper and walls not much heavier. It is interesting to note, in speaking of the Gnome cylinder construction, that the receptacles into which the spark plugs screw are internally threaded steel tubes welded into the side of the cylinder head by a secret welding process, the arrangement being shown in Fig. 3. The crank shaft is hollow, and through it pass the gasoline vapor and oil for lubrication. The construction is indicated in Fig. 3, the carbureter being plainly visible at the end of the shaft, while the oil pipes enter the shaft from above as shown. Just to the left and below the oil pipes may be seen the pumps which force the fuel and oil under pressure to perform their duties.

The vapor from the carbureter, after passing into the crank case through the hollow crank shaft, is admitted to the combustion space in the head of the cylinders through automatic inlet valves which are balanced by counter weights to eliminate the action of centrifugal force. The wonderful ingenuity of construction of these valves, making them easily removable through the cylinder head without the necessity of taking down the engine, must be remarked upon.

The exhaust valves are of course mechanically operated, the construction being clearly evident by an examination of the illustration

The magneto is behind the mounting framework in Fig 3, while the segment bearing part of the distributer rotates, and from the segments wires lead to the spark plugs, as clearly indicated.

Fig 4 shows one of the testing "gun carriages" in use at the Gnome works, with a motor in place Fig 5 gives an idea of the appearance of this wonderful motor in action, while Fig. 6 is a view of the 100-horse-power engine with fourteen cylinders This is the motor used by Leblanc and Grahame-White when the latter won the Gordon Bennett race at Belmont Park last fall.

The writer has made a deep study of internal combustion motor design, and is firmly of the opinion that the rotary engine is the aviation motor of the future, not to say the present The Gnome motor to-day holds practically all the world's speed records, which is remarkable when the handicap in favor of the reciprocating engine from the standpoint of time taken in development is considered.

In the case of the rotary motor, the cylinders and crank case serve as an efficient flywheel, thereby eliminating dead weight which is of no other use on the reciprocating engine. Vibration, due in the reciprocating engine to the unbalanced moving parts, is practically done away with in the rotary motor. With the rotary cylinders, water cooling, with its additional weight and complication, is not even thought of, for the rapid movement of the cylinders themselves through the cooling medium is all that can be desired A closer examination of the two types emphasizes many other advantages of the rotary motor, such as a reduction in size and weight for a given power, reduction of the number of bearing surfaces, etc.

The principal disadvantage of the rotary motor at present is the fact that castor oil is the only lubricant which has been found so far to be satisfactory, and on account of the nature of the oil used, comparatively large quantities must be employed. Critics have even called it "the oil-cooled motor." Furthermore, the use of this oil in such large quantities (varying from one part of oil to three or four of gasoline) makes frequent cleaning necessary. In spite of this, however, the Gnome engine has forced its way to the front rank, against the adverse criticism and even abuse which has always stood in the path of true progress, until to-day it is the engine above all others where the greatest power and reliability are derived for the least weight. The idea of the writer in speaking so forcibly of the superiority of the Gnome motor is to awaken engine designers in America to the evident superiority of the rotating type over the reciprocating, with the hope that American manufacturers will attack the problem of rotary motor design, and, with their characteristic ingenuity and enterprise, produce an American aviation engine which will stand second to none. The rotary motor of the Gnome



Fig. 3.—View of side and rear of the new 70-horse-power Gnome.

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type is the nearest approach yet made to the ideal internal combustion engine—the gas turbine—and as such demands recognition by every American manufacturer. Incidentally, the writer has heard on good authority that the Gnome company are experimenting with a two-cycle engine of the rotary type. Since the proper cooling and scavenging of the cylinder of this class of motor are the two hitherto almost insurmountable obstacles, it would seem the rotary principle is particularly adapted to the development of this class of engine.

The Tallest of Tall Buildings

WORK is now in progress at Broadway and Barclay Street on the foundations of one of those huge steel-and-concrete office buildings, which are such a characteristic feature of the modern architecture of New York city. The Woolworth building, as it will be called, will have a frontage of about 155 feet on Broadway, between Barclay Street and Park Place, and it will extend into the block for a depth of about 200 feet. Its most distinguishing characteristic, at least to the popular eye, will be its great height, for its crowning element, ball or lantern, or finial, or whatever it may be called, will stand exactly 775 feet above street level.

At the site there is the characteristic deep bed of quicksand, and through this the foundations are now being carried down everywhere to solid rock, which is about 110 feet below the sidewalk. Hence the structure, from lowest foundation to its topmost point, will have a total height of 885 feet.

The main building, which will cover the whole area except for a 35 by 96 foot interior rear court, will contain 31 stories, and above this there will rise from the center of the Broadway façade a great tower, 84 by 86 feet square, which will extend, with vertical walls, to the 50th floor, with an offset at the 42nd floor, where the dimensions are reduced to 69 by 71 feet, and at the 47th floor, where there is a further reduction to 59 by 61 feet. The height from the sidewalk to the 31st floor, which marks the top of the main roof, will be 400 feet. The tower extends another 370 feet, from the 31st to the 50th floor, making the height above sidewalk to this point 670 feet. Here it is surmounted by a pyramid which is 54 feet square at the base, in which are five additional floors and an observation gallery, the last-named being at an elevation of 730 feet above the sidewalk. There are two floors below street level, and the general height of each story throughout is 12½ feet. The Woolworth Building is designed in accordance with the Building Code of this city, which allows 150 pounds per square foot load on the first and basement floors and 75 pounds per square foot on each of the other floors. When we remember that a uniform wind pressure of 30 pounds per square foot over the whole surface of the building has been provided for, it can be understood that the stresses from wind alone reach enormous figures. The maximum direct compression from wind pressure on one single column of the building reaches 2,500,000 pounds to which must be added 200,000 pounds delivered from the portal bracing.

The steel framework alone will contain 20,000 tons of steel. Its various columns will be supported on 69 piers of partly reinforced concrete, which are now being sunk to solid rock at an average depth of 110 feet below street level. Except where conditions call for rectangular shapes, the caissons are cylindrical, and they vary from 8 feet 2 inches to 18 feet 9 inches in diameter. They are loaded to a maximum of 18 tons per square foot. Generally speaking, the axes of the columns stand in line with the axes of the caissons, but in some cases they are placed eccentrically, and their load is transferred to the center of the caisson by means of heavy steel girders acting as cantilevers. These girders are very massive and stiff, being as much as 2 inches in thickness in the web, and having an average depth of 8 feet, with a maximum weight of 60 tons.

From the 55th to the 50th floor, the inclined members of the pyramid take care of the wind stresses. From the 50th to the 47th floor, deep floor girders with solid gusset plates serve the same purpose. From the 42nd to the 28th floor, the exterior wall columns are braced against the wind by extra deep wall girders, and by knee braces, reaching well in to the center of each story. From the 28th floor to the street, every panel between the outside columns facing Broadway and the opposite face of the building is stiffened by a full-depth web portal with heavy flanges. Transversely to Broadway, the bracing is by means of single portals, reaching across the full width of the tower.

There are in the building 60 main columns of closed box section. The maximum load on a single column reaches the enormous figure of 4,750 tons, and this column measures at the base, 2 feet 6 inches by 3 feet 8 inches, the total cross section of metal being 650 square inches. The architect of the building, Mr. Cass Gilbert, and his consulting and designing engineer, Mr. Gunvald Aus, are to be congratulated on the design. The SCIENTIFIC AMERICAN has frequently suggested that for good architectural effect it would be advisable, in these tall buildings, to accentuate the vertical lines at the expense of the horizontal. Mr. Gilbert has done this to a marked degree, and in his treatment of the tower he has introduced those open-work pinnacles or 'towerettes," if we may coin a word, which the medieval builders used to such happy effect in the towers of their Gothic cathedrals.

The exterior walls are to be built of granite up to the fifth floor, and above that of terra cotta. The building will be served by 26 elevators, all of which will be thoroughly fireproofed, also there will be four commodious fire-escape stairways, widely separated from one another, and each built in a fireproof shaft. The structural steel will have a coating of one inch of cement mortar, their interior spaces will be filled in solid with concrete or mortar, and the whole will be inclosed in a shell of terra cotta 3 inches thick. There will be no wood whatever nor any inflammable substance in the building. Doors, windows and trim will be of pressed steel, floors of mosaic, and exposed exterior windows will be glazed with wire clamps.

Correspondence

[The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.]

Our Merchant Marine.

To the Editor of the SCIENTIFIC AMERICAN:

The issue of the SCIENTIFIC AMERICAN for July 15th was very interesting. The suggestions for restoring the American merchant marine run on the old lines, viz., differential duties or subsidies. Free ships are anathema.

Mr. Sulzer believes that differential duties on goods brought in by American steamers will restore the American flag to the deep-sea trade. He bases it on the fact that up to 1828, differential duties freighted in American ships were in effect.

The fact is ignored that, although after 1828 the differential duty law was no longer in effect, as stated by Mr. Sulzer, our shipping continued to grow until at the time the civil war broke out we were a close second to Great Britain in shipping.

Why we grew in shipping till we had almost overtaken Great Britain and were fast outstripping her is not touched upon; no mention is made of the fact that we had the natural resources in abundance, i. e., timber of the best quality that grew down to the edge of the ocean. This naturally stimulated a seafaring people to build ships. The ventures were successful; shipping grew, free from the building traditions of the old world, new types were, in the course of time, evolved, that were not alone marvels of beauty, but great deadweight carriers as well; and for speed they had no equals among the productions of European yards.

Is it any wonder, then, that shipping in the United States grew so fast, that the supremacy of Great Britain as a shipping nation was threatened?

In those days there was no cry that shipping was unprofitable; the Stars and Stripes were seen in every sea, and we traded every country on the globe. Then came the civil war and the transfer of our ships to foreign flags; later the introduction of the iron-built steam tramp, and gone was the occupation of the wooden sailer, and the grass grew in the shipyards of Massachusetts and Maine.

Yet to-day the United States makes more iron and steel than Great Britain and Germany together. On the authority of iron and steel manufacturers, we manufacture it cheaper than anywhere else in the world. We have shipyards that can turn out as good ships as can be turned out anywhere in the world. With all these advantages, we are told that we cannot build as cheaply as can builders abroad.

American capital is furnished to build steamers in foreign shipyards, and many of these steamers are built from plates exported from this country.

In spite of this, Mr. T. G. Roberts, naval constructor U. S. N., apparently believes that an adequate merchant marine can be built up only by discriminating duties and subsidies. In his mind the results of a free-ship bill would only result in "splendid imaginary shipping." The shipping owned by Americans is not at all imaginary, there are many millions of dollars invested in shipping running under foreign flags, application has been made to Congress for the privilege of placing some of it under the American flag, but permission is withheld. Why?

And yet, Mr. Roberts states in the heading of his article, "The Merchant Marine as an Auxiliary to the Navy," the navy would need some nine hundred merchant vessels to draw from in case of war.

Allow that our coast yards could turn out fifty 5,000-ton steamers annually, it would take something like eighteen years to build them, and it is not to be supposed that our navy will stand stationary during that period; neither does he take into account the annual growth of commerce and the consequent need of new tonnage annually.

Several fleets now operated under foreign flags are owned by Americans, and in case of war foreign governments could take them as auxiliaries to their navies. It seems but wisdom to allow such tonnage American registration. If Americans will not avail of the privilege, then it may become necessary to take further measures to insure American tonnage under the American flag.

The passage of such a measure might mean the avoidance of a great deal of trouble in the future. Even though foreign flags fly over American-owned tonnage, it may be expected that American owners will look to the United States Government for aid, should their investments be seriously threatened, and it would be no source of gratification to Americans in case of war, to find the tonnage for which we furnished the capital used in conjunction with a foreign navy to subjugate us.

Congress has just passed a reciprocity treaty with Canada covering farmers' produce. We can enter reciprocity with Great Britain in shipping by passing a free-ship bill. Great Britain now allows American-built ships British registration when owned by British citizens. Let Congress enact a law granting American registration to American-owned British built ships for the Philippine and foreign trade only.

Chicago, Ill. CHARLES DEPSEY.

Observation of the Kiess Comet

To the Editor of the SCIENTIFIC AMERICAN:

The Kiess comet was observed here early on the morning of July 20th, 1911, by the writer, with a 3-inch refractor. As it is equivalent to about the seventh magnitude, and easily visible through a small telescope, it should be perceptible even in an opera glass. It is rather small, though bright, and resembles a nebula, and is moving in a southwestern direction. At about 2 15 A. M. on July 20th it was approximately 4 degrees west and a very little to the south of the star Iota Aurigae, which is of the third magnitude and not far from Capella, so can be easily located from this object. The position of the comet on July 12 8412 G. M. T. was R. A. 4 h. 41 m. 35.2 s., Dec. + 31 deg. 19 min. 20 sec.

Berlamont, Mich. FREDERICK C. LEONARD.

Why Left-hand Plows are Used in the Middle West

To the Editor of the SCIENTIFIC AMERICAN:

In the issue of the SCIENTIFIC AMERICAN for June 17th 1911 in "Notes for Inventors" I note the comment on the extensive use of left-hand plows in southern Ohio, Indiana and Illinois. The explanation of such use is found in the fact that these localities were largely settled by people from Southeastern Pennsylvania, Maryland and southward, in which latter localities it was and is to a large extent, yet customary to drive two or even four horses with a single line, the line being attached to the left-hand or "near" horse only, the "off" horse being guided by a "jockey stick," one end of which is tied to his bit and the other end to the "near" horse's hame or collar. In plowing with such an arrangement it would obviously be necessary to place the guiding or "near" horse in the furrow, which would necessitate the use of a left-hand plow.

The custom of single line driving has probably been largely abandoned in the above first-mentioned localities, owing to the extra effort and time required to train the horses, but the use of left hand plows has continued, and probably will continue indefinitely, due to the fact that each generation learns to plow with the tools of its elders, and having once learned with a left-hand plow, the change to right-hand is not easy.

E. W. HEISS.

Patent Office, Washington, D. C.

Abstracts from Current Periodicals

Phases of Science as Other Editors See Them



Fig. 1. Greek undergarments.



Fig. 2.—The Egyptian sarcophagus produced hygienic results although designed for other purposes.

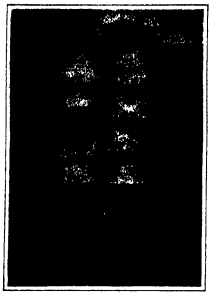


Fig. 3.—Babylonian drain which shows that ages ago the proper disposal of sewage was attacked hygienically.

Historical and Popular Exhibits at the International Hygienic Exposition in Dresden

TWO of the most interesting departments of the International Hygienic Exposition which is being held in Dresden are the historical and popular sections. In the historical section the history of hygiene is illustrated by numerous models and pictures, as well as by other means, and similar methods are employed in the popular section, the purpose of which is to give the average visitor a clear and non-technical presentation of the progress of hygiene and to impart some practical information concerning the laws of health.

Illustrations and descriptions of some of these exhibits are here reproduced from a recent issue of the *Illustrirte Zeitung*, which is filled with interesting matter relating to the exposition, to which it is entirely devoted.

In the historical section the visitor is enabled to review the progress of hygiene from the infancy of civilization to the present day. The record is very incomplete, and is made up of fragments laboriously unearthed by the archæologist, for the writers of history and the makers of monuments deal almost exclusively with wars and kings, and devote little attention to the life of the people.

We know from excavations that the Celts and Germans, before they came into contact with Roman civilization, lived in caves and cellars, and the human bones found in these underground dwellings show that gout and rheumatism were very common, as might be expected. The inhabitants of the upper Nile region were also grievously afflicted by gout.

These northern tribes, after the primitive age of furs and skins, wore close-fitting breeches and sleeved shirts of thick wool, in striking contrast to the light and flowing garments of the Romans and Greeks (Fig. 1), and in entire accordance with the difference in climate.

The disposal of the dead is a subject of great hygienic importance, and is well illustrated in the historical section. Although cremation, embalming and the sealing of corpses in tight oaken coffins, stone sarcophagi (Fig. 2) and vaults, were probably not adopted for hygienic reasons, they produced hygienic results, especially in view of the widely prevalent custom of keeping the remains of diseased members of the family very near or even in the house.

Among other customs of hygienic value but non-hygienic origin may be mentioned bathing, which in many lands was regarded as a religious, rather than a hygienic duty.

Again, the ritual requirement of perfect health in animals which were offered in sacrifice (and which by the way, often constituted the only animal food used) was firmly established among the Babylonians, Egyptians, Jews and Greeks, ages before there was any official inspection of slaughter houses.

Hygienic motives, however, were consciously followed by the Greeks, Romans and other ancient peoples in house building, paving, draining, sewerage, water supply, the construction of private and public baths, and in many other things. An ancient Babylonian drain is illustrated in Fig. 3, while Fig. 4 shows a model of the outlet sluices of the Alban Lake.

Two institutions of great hygienic value originated in Mesopotamia and were brought to Europe by the Jews: the weekly day of rest and the isolation of diseased persons. In the Middle Ages the precepts of Leviticus were developed into a system of sanitary regulations which, in a desperate warfare waged for



Fig. 5.—A leper's rattle.



Fig. 6.—A Vienna pest house in 1679.
From a contemporary engraving.

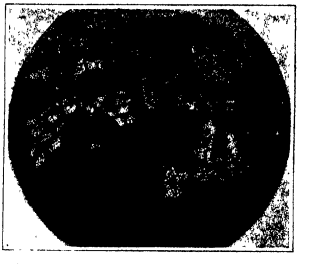


Fig. 7.—Bathing customs in the fourteenth century.

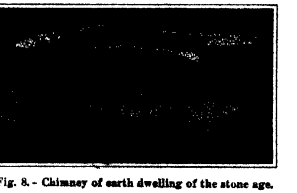


Fig. 8.—Chimney of earth dwelling of the stone age.



Fig. 4.—Model of outlet of the Alban Lake.



Fig. 9.—Medieval and modern shoes, clogs and goloshes.

Illustrations by courtesy of *Illustrirte Zeitung*

EXHIBITS AT THE INTERNATIONAL HYGIENIC EXPOSITION, DRESDEN

centuries, finally defeated the dreaded Asiatic invader, leprosy. Fig. 5 shows a rattle used by the leper to give warning of his presence.

The epidemics of the plague, and especially the black death (1348-1350) led to the establishment of municipal and state quarantine and other preventive measures which are still employed. The Romans had small military hospitals, but general hospitals, leproseries and pest-houses (Fig. 6) originated in the Middle Ages.

The characteristic German fondness for bathing was freely indulged even in the Dark Ages, when every village had its Turkish bath. The fashion prevailed, not without abuses (Fig. 7) throughout the Middle Ages, but waned in the seventeenth century in the general depression caused by the Thirty Years' War. In the eighteenth century the "return to nature" which followed the French Revolution led to a resumption of the practice of bathing in streams, which had previously been prohibited as unseemly. At that time hygiene was earnestly studied in France, the war against the corset was inaugurated, and, in 1802, a general council of health was founded. During the same period Jenner, in England, introduced vaccination, which in a few decades put an end to the frightful epidemics of smallpox which had long ravaged Europe. The epidemic of cholera in England in 1831 contributed greatly to the promotion of cleanliness and of hygiene in general.

These are a few of the subjects that are copiously illustrated by the historical exhibits of the exposition, which also show the hygienic progress that has gradually been made in house building, cooking, heating, lighting and clothing, in the installation of prisons, barracks and abattoirs, in travel by sea and land, etc. Fig. 8 shows a model of a chimney such as was used in underground dwellings after the need of such a device had at last become apparent, and Fig. 9 exhibits a diversified assortment of mediæval and modern foot gear.

Few people appreciate the great boon of health until it is lost or seriously impaired. This fatalistic indifference is explained by the general ignorance of hygienic laws. Great advances have been made in physiology in the last few decades, and the cause and the means of prevention, if not of cure, of nearly every disease are known by physicians, but very little of this knowledge has reached the mass of the people. The popular section of the Hygienic Exposition is designed to impart this knowledge in such a form that it can be understood at a glance. The attentive and intelligent visitor will leave this section impressed with the wonderful complexity of the body and the value of good health, and filled with the resolve to preserve this precious gift with jealous care. The

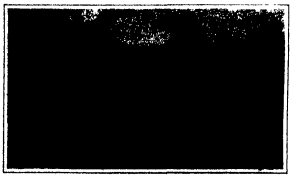


Fig. 10.—A very bad well.

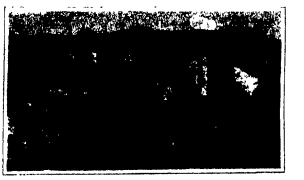


Fig. 11.—A bad well.

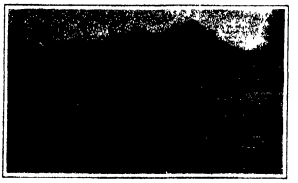


Fig. 12.—A poor well.



Fig. 13.—A good well.



Fig. 14.—Types of dwellings; from left to right, ancient Jewish, Amazon Indian, Saxon farmhouse, Canadian Indian, Herero.

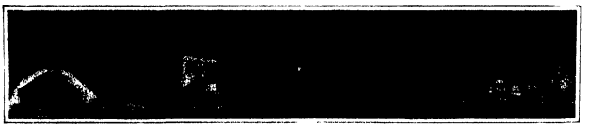


Fig. 15.—Types of dwellings; from left to right, Eskimo, Italian, old German hut, earth dwelling, Schwarzwald farmhouse.

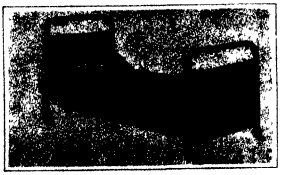


Fig. 16.—Hygienic bed.

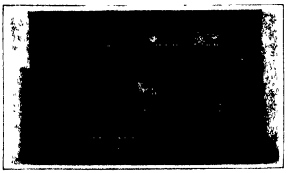


Fig. 17.—Alcove bed.



No. 1.—92.6 No. 2.—97.7 No. 3.—94.1 No. 4.—99.3 No. 5.—89.6 No. 6.—86.0 No. 7.—79.7 No. 8.—77.9

Fig. 21.—Heating and cooling effect of various hats, in the sun, with an external temperature of 96.8 deg. F. The temperature inside each hat is indicated by the figures printed under it.

Illustrations by courtesy of *Illustrirte Zeitung*.

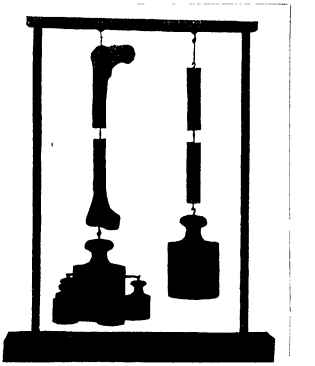


Fig. 18.—Bone is stronger than oak.

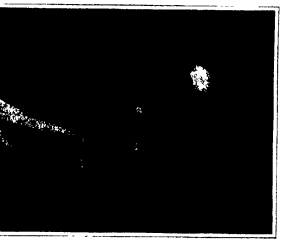


Fig. 19.—Model showing force of heart's beat.

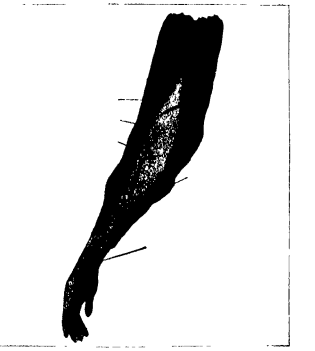


Fig. 20.—The use of clothing.

EXHIBITS AT THE INTERNATIONAL HYGIENIC EXPOSITION, DRESDEN

little detailed description of this section that can be given in this article will best be presented in connection with the few illustrations here reproduced

Figs 10 11, 12 and 13 relate to water and its impurities Fig 10 shows an open well lined with a wall of stone and situated near a farmhouse and stable Not far off is the village pond, on the shore of which stands a small slaughterhouse The water of the pond filled with impurities derived from the slaughterhouse, the washing of clothes and many other sources seeps through the soil to the "ground water" which supplies the well Other water carrying impurities from the stable and dung heap, drains, etc, enters the well through fissures in the wall, and dust and other things fall into the open mouth, so that the well water is necessarily impure, and may contain germs of typhoid and other diseases The conditions shown in Fig 11 are little better The well is covered and provided with a pump, and is apparently protected from surface impurities by the impervious stratum of yellow loam which it traverses in its descent But the wall and the wooden cover of the well in time develop fissures which admit impure water from the ditch at the left and from other sources Moreover, a cesspool (shown at the right) of later and very faulty construction, also penetrates below the stratum of loam, and directly contaminates the ground water Such wells often cause epidemics which are carried through a whole village in various ways, for example, a careless baker who allows a washerwoman to test the freshness of his bread by squeezing the loaves with her wet hands

The pump well shown in Fig 12 is apparently well protected by layers of cement and clay, and the cesspool is made tight by the same means, but the ground water is contaminated by neighboring sources of impurity

Fig 13 shows a deep pipe well, driven through one stratum of yellow loam and two of blue clay The water is thoroughly protected from contamination from the surface above and near it, and is probably pure

Various types of dwellings are illustrated in Figs 14 and 15 Beginning at the left of Fig 14, the first drawing shows an ancient Hebrew house, which consists essentially of a high wall inclosing an open night shelter The second dwelling is the primitive hut of the Indians of the Amazon consisting merely of a roof placed on the bare ground without walls The third picture shows a model of a farmhouse in Saxony, with the roof turned up to show the interior The sleeping- and living rooms kitchen (usually chimneyless), barns and stables are all under one roof and within one wall, in defiance of the most elementary hygienic requirements The fourth dwelling is a Canadian Indian wigwam The tent is one of the most primitive of human dwellings, and is found chiefly among hunting and nomadic tribes The open top of this Indian tent is provided with flaps to control the outflow of smoke Behind the tent is shown a fence which serves as a wind shield, and to right and left are stacked the sledge poles on which the tent and other possessions are carried on journeys The fifth and last dwelling shown in Fig 14 is an African Herero hut, consisting of an inverted plaited basket, like an old fashioned beehive, plastered with clay and cow dung The first (left hand) drawing in Fig 15 represents a vertical section of a Point Barrow Eskimo hut built of logs and covered with snow as a protection against cold The hut is entered by creeping through a low doorway The second picture shows an Italian peasant's house The interior is dark and uncomfortable, the windows are not glazed, the roof is flat, and is a favorite evening resort The third picture shows an ancient German hut, built of tree trunks wattled with brush Huts of this type are still used by primitive tribes in various parts of the world The fourth picture shows a prehistoric German earth dwelling consisting of a pit surmounted by a dome of brush covered with clay or moss The fifth and last picture shows a farmhouse in the German Schwarzwald, in which house, barn and stables are combined as in the Saxon farmhouse

Fig 16 shows a modern hygienic bed and Fig 17 the old fashioned alcove bed which was apparently devised to prevent access of fresh air to the sleeper

Fig 18 illustrates the comparative tensile strength of human bone and of oak A rod of bone having a cross section of one square millimeter will sustain a weight of 17 kilogrammes, while a similar oak rod will sustain only 10 kilogrammes By pressing the lever and raising the weight shown in Fig 19 which represents the effort made by the heart in each pulsation, the visitor can obtain a practical idea of the great force of the heart's beat

The effect of clothing in diminishing radiation of heat from the body is illustrated by Fig 20 When the temperature of the air is 50 deg F, the temperatures of the bare hand, the skin of the arm clad in a knit shirt and a woolen coat, and the other surfaces of the shirt sleeve and coat sleeve, are respectively 84.2, 89.6, 78.8 and 69.8 deg F. Hence the difference in temperature between the coat sleeve and the air is only 19 8 degrees, while the difference between the bare hand and the air is 34 8 degrees, and the radiation from the clothed arm is correspondingly less than that from the bare hand.

The heating and cooling effects of hats and caps are illustrated in Fig. 21 In the sun, with an external temperature of 96 8 deg F, the temperatures inside the hats are as follows No 1 yacht club cap, 98 6; No 2, Prussian helmet, 97.7, No. 3, English cap, 94 1; No 4, black derby hat, 92 3, No. 5, high silk hat, 89 6; No. 6, soft white felt hat, 86, No 7, light straw hat, 79 9, No 8, Panama hat, 77.9 deg F.

The First International Congress of Aerial Law

ON May 31st and June 1st and 2nd, the First International Congress of Aerial Law met in Paris under the auspices of the *Comité International Juridique de l'Aviation* The efforts of the committee are directed especially to the establishment of practical regulations for aerial traffic as such regulations shall become necessary The other objects of the committee are the collection and preservation, in a central place, of all interesting cases and documents relating to aerial law, the discussion and preparation of laws passed by parliaments and local authorities, and the imparting of information and advice to societies and individuals who may present questions concerning the legal aspects of aerial traffic In some cases the committee may assume the role of arbitrator in disputes

The committee has undertaken the preparation of an aerial code consisting of five sections (general public rights, private rights, police ordinances, custom house regulations and penal laws)

In a recent issue of the *Deutsche Zeitschrift fur Luftschiffahrt* the work of the International Committee is thus described by the head of the German delegation, Dr Alex Meyer

The separate chapters of the code tentatively adopted by the international committee are submitted to each national delegation and the result of the deliberations of each national delegation is communicated to the international delegate in Paris The diverse views thus collected from all the countries are discussed at the monthly sessions of the international committee, and form the basis of a provisional chapter, the definite form of which is established at the annual international congress

The first congress, just held, determined the method of voting, and drew up the first five chapters of the code, relating to general public rights It was decided that each country represented should have one vote The five chapters as adopted read substantially as follows

CHAPTER I GENERAL RULES OF AERIAL TRAFFIC

Article 1 Aerial traffic is free, with the reservation of the right of each State to make certain regulations for the space above its own territory, for the preservation of its own safety and the lives and property of its inhabitants

CHAPTER II NATIONALITY AND REGISTRATION OF AERIAL VESSELS

Art 2 Every aerial vessel must have a single nationality.

Art 3 The nationality of a vessel is determined by that of its owner When the owner is a company, the nationality of the vessel is that of the place where the company has its seat If a vessel belongs to several owners of different nationalities, its nationality is that of the owner who possesses a two-thirds interest in the vessel.

Art 4 Every vessel must bear an easily recognizable mark of nationality

Art 5. Every vessel must carry papers of identification containing all necessary information.

Art. 6. No owner of an aerial vessel may extend his flight beyond the limits of an aeronautic park unless the vessel has been registered in a list kept by the proper authorities. Each State shall make rules for registration in its own territory

Art 7 Every vessel must carry a mark indicating its place of registry

Art 8 The registration list shall be published.

CHAPTER III. LANDING.

Art. 9. Landing in open fields is permitted.

Art 10. It is forbidden to land in fortified places or within a radius established by the military authorities, or within towns and cities except in open spaces designated by the authorities.

Art. 11. The owner of the vessel shall be liable for all damage caused by landing, except in so far as such damage is caused by the fault of the party injured.

CHAPTER IV. JETTISON.

Art. 12 Jettison includes all voluntary dropping of objects from the vessel.

Art. 13. Except in cases of imminent peril it is forbidden to drop any object which can injure persons or property in any manner.

Art. 14. In case of injury so caused, the owner of the vessel shall be held liable.

CHAPTER V. WRECKED AND ABANDONED VESSELS.

Art. 15. Every person who finds a damaged or abandoned aerial vessel, or any part thereof, must notify the proper authorities.

Art. 16. The authorities so notified shall immediately take proper measures to preserve the wreck and restore it to its owner

Art 17. The owner may claim his property at any time within one year from the day of discovery and after he has paid the cost of salvage and preservation The owner is also required to pay to the finder a reward equal to 10 per cent of the value of the recovered vessel, after all costs have been paid.

Astronomical Notes for August

By Rev. Rudd W. Roberts

THE summer is the best season of the year for observing and studying the heavens. It is warm and the open air invites us all. It is especially favorable for the use of a telescope, for the "seeing" is much superior at this time. An instrument is worth one twice its size used in the winter season For these reasons we give below some notes with the hope that they will guide those interested in the study of the heavens

The Asteroids.

During the month of August Ceres, Juno, Pallas and Vesta may all be seen. As will be seen from the ephemeris given below Ceres passes just to the north of Eta Geminorum (R. A 6 hr., 9 min.; Dec north 22 degrees and 32 min.), about midnight on the 4th. It will lie about half a degree to the north of this star at this time. About noon of the 9th it will be directly north of Mu Geminorum—about half a degree above it. The R A. of this star is 6 hr. 17 min and its Dec. is N. 22 degrees and 33 min

Pallas is in the constellation Eridanus and toward the close of the month passes near the star 39 in this constellation Juno although of nearly the eleventh magnitude should be seen in a fair sized telescope on the 20th when it is about a half degree above Zeta Virginis The R. A. of this star is 13 hr. 39 min., and its Dec is south, 8 min Vesta is constantly growing brighter during August and at its beginning is near Delta Geminorum, and for a short time traces very closely the path of Neptune for the early spring. We give below the ephemeris for these asteroids:

CERES.

Mag	Date	Right Ascension	Declination.
8 71	Aug 4	6 hr 8 3 min.	N 23 deg 3 min.
	Aug 12	6 22 0	23 14
	Aug 20	6 35 4	23 21
8.53	Aug 28	6 48 5	23 26

PALLAS.

8.74	Aug 4	3 hr 25.9 min	S. 2 deg 28 min
	Aug 12	3 35.8	3 40
	Aug 20	3 45 0	5 5
8 39	Aug 28	3 53.5	6 44

JUNO

10 74	Aug 4	13 hr. 14.2 min.	N. 0 deg 59 min.
	Aug 12	13 21 6	0 10
	Aug 20	13 29 5	S. 0 41
10.94	Aug. 28	13 37 8	1 33

VESTA

8.65	Aug 4	7 hr 17.5 min	N. 21 deg 50 min.
	Aug 12	7 32.2	21 30
	Aug 20	7 46 6	21 6
8.53	Aug. 28	8 0.8	20 39

Occultation of Stars by the Moon.

In our article of April 1st attention was called to the pleasing experience of watching a star suddenly dart behind the moon during an occultation. Below is given the Washington Mean Time of Immersion and Emersion of three stars which may be watched during August.

Date.	Star's Name.	Time of Immersion. Hr.	Min.	Time of Emersion. Hr	Min.	Mag.
August 5th. . .	10 G. Sagittarii	10	17 P. M.	11	5 P. M.	5.7
August 8th . . .	25 Capricorni	8	21 P. M.	9	39 P. M.	6.0
August 10th. . . .	27 Capricorni	2	6 A. M.	3	15 A. M.	5.7

Planetary Details to be Observed.

On August 28th the moon passes very close to Jupiter. Mercury is at its greatest elongation east of the Sun on the morning of the 12th and should be watched for about this time of the month, in the evening sky. It represents a crescent of about the same as the quarter moon at this time. Venus is at its greatest brilliancy on the 10th and is at this time half way been a quarter-moon crescent and a new-moon crescent.

The New Era of Blood-transfusion

A Triumph of Surgical Skill

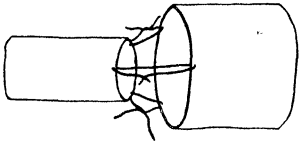
By Genevieve Grandcourt

IT is not seldom that we read newspaper accounts like the following, which appeared early in the year:

"Philadelphia, Feb. 20th.—With a subject selected from the score or more volunteers who had offered their blood in response to a want advertisement that appeared in a newspaper here this morning, a remarkable transfusion operation was performed to-night in the Polyclinic Hospital The patient was David Poloco, a poor tailor suffering from internal hemorrhages, whose family had already given all the blood their physicians would allow, and had advertised to give their savings for a volunteer in a last effort to save the life of their relative.

"The subject, who hid his identity under the name of 'Smith,' was a powerful looking man about 26 years old who came to the hospital in a taxicab and is said to be a member of a prominent family in this city

"The transfusion was permitted to continue for thirty minutes, when the white face of the patient had assumed a rosy hue, while the face of the subject, which at the beginning of the operation was ruddy, had become almost deadly white An examination of the blood of the two men at the close of the operation showed that the coloring matter in Poloco's blood had risen from 18 to 47 per cent, while that of the subject had decreased from 85 to 60 per cent"



First stitches or stay-sutures.

CARREL METHOD

Dr. Crile of Cleveland, who more than anyone else has developed transfusion (the name of experimenters in the past two hundred years is legion), says that he meets with the warmest enthusiasm in asking relatives to make this sacrifice, while Dr Carrel describes the moral exaltation of a young man who gave his blood to his aged father. It would thus seem that the victory registered over the material is as blood-stirring as the surgical triumph of transfusion itself.

Not that the operation is any longer dangerous Professional donors of blood have been known to return to hospitals two and three times to repeat the experience; they are often in condition to work the next day. The ordeal is painless About half an hour beforehand, each patient is given a hypodermic injection of morphine Local anaesthesia is used, a small cut being made over the vessels

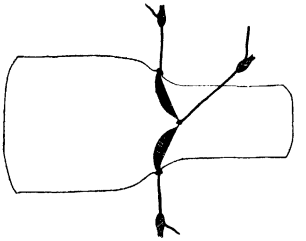
Reducing the surgical history of transfusion into its elements, it began with one Frenchman and was concluded by another; one in the 17th the other in the 20th century—Jean Denys, who performed the first real operation of the kind, and Alexis Carrel, who found the way to suture the ends of severed blood vessels

Denys, through animal-experimentation, arrived at conclusions as to choice of blood-vessels in transfusion which are held valid to-day. He showed that the artery (as carrier for the quick-flowing red blood) should furnish the supply, and the vein of the sick man should be selected to receive it, as affording the most direct route back to the right heart and the lungs where the blood becomes re-vitalized Artery and vein he connected with glass-tube

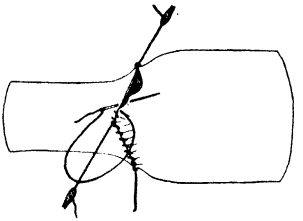
He was not sustained by the professional opinion of his time, partly because Harvey's discovery of the circulation, though forty years old, was still ridiculed in Paris, but also in view of the demonstrated negligible quantity of blood capable of being transfused. It had been known for a long time that endothelium, lining arteries and veins (now known as the intima), has the property, practically peculiar to itself, that blood in contact with it does not clot, while, when brought into contact with any other substance, it soon coagulates and ceases to flow

Denys found that the amount of blood transfused varied according to the size of tube used, and also according to the different size of human and sub-human blood-vessels; though he knew there was no way of satisfactorily gaging the flow save by the pulse of the donor which during the operation must be transmitted from artery to vein. As little as four ounces had brought patients out of syncope, and failure in one case that had promised well, was found on post-mortem to be due to intestinal gangrene.

After initiating the work, he got into trouble In transfusing blood from the femoral artery of a calf into the veins of an insane man, he was twice successful; but the third trial, made at the insistence of the patient's wife, resulted fatally Denys was sus-



Tying of stay-sutures.

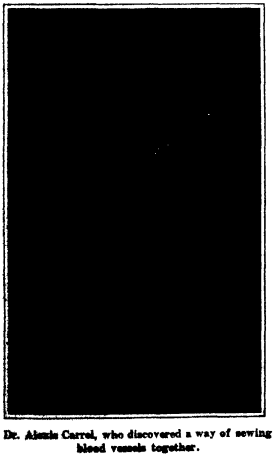


Final suture of artery and vein, showing over-and-over stitches completed between two of the stay-sutures.

CARREL METHOD

picious and wished to open the body The widow refused, saying he had "experimented" on her husband, and demanding a price for her silence The doctor's answer was a complaint to the authorities, and in the sequel the French government prohibited the practice

From this time until early in the 19th century, this operation was taken up, dropped and taken up at intervals until the method came into vogue of drawing blood from the subject, whipping out the clots

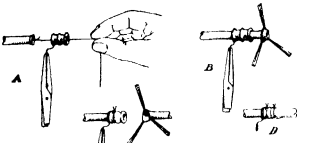


Dr. Alexis Carrel, who discovered a way of sewing blood vessels together.

(*defibrinating* it) and injecting it into the patient's veins

Against this method, the great French physiologist Magendie, gave early warning His experiments showed that in this way serious symptoms could be made to develop in perfectly healthy animals, and he suspected that the clotting took place now inside the body instead of out, producing paralysis and death During the Franco-German war, this method was tried on thirty-seven wounded soldiers with only thirteen successes

A few years later, science began taking those enormous strides which especially in physiology and bio chemistry have covered more ground than in all preceding history It was learned that that microscopic body, the white corpuscle, was back of the blood clot, that when the ends of blood-vessels were cut, it began



From Crile's "Hemorrhage and Transfusion" Appleton & Co

A Vein being drawn through ring *B* Cuffing vein over ring, showing hemostats *C* Vein tied in groove next handle of ring, artery in position to be drawn over vein *D* Complete anastomosis of artery and vein

CRILE METHOD

to manufacture fibrin ferment Hence, defibrinating the blood did not solve the problem as only the solid part of the clot was whipped out and the white corpuscle's fibrin ferment remained in the blood And it was only when this clotting inside the blood vessels did not take place in a *vital* organ that Magendie's prognosis was not realized

Thus the only solution was to join the ends of the blood vessels together so that, as regarded the circulation, they should become one But stitches seemed out of the question, since, being foreign bodies, they were as objectionable to the white corpuscle as tubes of glass or paraffine Yet, if hazardous operations of various kinds ever were to be made safe to be able to join blood vessels end to end was imperative

Payr answered this call with a magnesium-tube, but the technique was undeveloped and proved clumsy Meantime, Carrel was investigating with the blood-vessels of dead human bodies, he applied his technique to living animals, and it worked He had found the way to do that which everyone had said could not be done, to sew the blood vessels together without clotting or leakage

The principle of the Carrel method consists in "everting" (turning out) the cut lips of the vessels in such a way that when the openings of the two are brought together, their linings touch Needle and thread is then drawn through *sterilized vaseline*, passed through the outer and upper edge of the artery in its entire thickness, and brought out through the inner and upper surface of the vein Two similar stitches are made in the blood vessels (see diagram), in all instances leaving about four inches of thread uncut after tying, to serve as a handle for the assistant surgeon to tilt the blood-vessels in order to join them end to end, as shown in the accompanying illustration

Carrel's discovery was hailed with thanksgiving and he made an early application of it in transfusion by saving the life of a four day-old baby, this as recently as 1908

Dynamics.

Before Carrel's success, Crile was studying to develop transfusion along mechanical lines He used Payr's tube, discarded it for Carrel's stitches, and then deciding that the less skillful surgeon needed an easier method, developed the Payr tube The instrument he has evolved is a cannula or ring-with-handle, and is so tiny as scarcely to slip over the point of a pencil

The Crile method is to draw the vein *through* the ring and cuff its edge back on the ring, there it is

(Continued on page 129)

HANDY MAN'S WORKSHOP

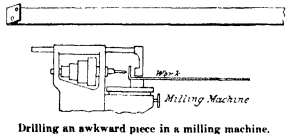
[The Editor of Handy Man's Workshop will be glad to receive any suggestions for this department and will pay for them, promptly, if available.]

Drilling an Awkward Piece

By G. H. Ander

THE following may be worth while to many, as it was to those it concerned when it happened

I was working in a railroad repair shop one day when I observed two machinists working a ratchet drill in order to make holes in a piece of iron about 12 feet long with one end bent up about 8 inches. The holes were being made in the short part (see illustration). The shape of the iron to be bored or



Drilling an awkward piece in a milling machine.

drilled prevented it from being done in a drill-press or lathe.

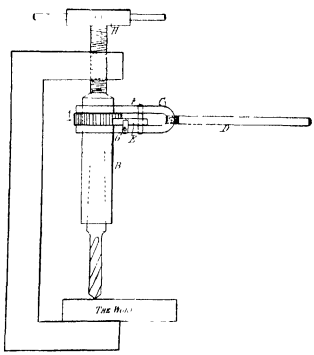
The men had the iron and ratchet drill with its holder clamped to an iron table and were working hard for a considerably long time to make the holes.

I asked the foreman if there were many jobs like that in the place. "Yes" he said "we have had to make quite a number of them in the last three years, and we will have many more." Then I said: "I suggest that you drill those holes by using that milling machine" (pointing to one which was used very seldom). "Well well," he exclaimed, "I never thought of that before, and neither did the machinists who were told to perform the job." After that the holes were always drilled in the milling machine by one man and naturally in very much shorter time than it used to require two men with the ratchet drill.

How to Make a Ratchet-drill

THE ratchet drill here illustrated will be found extremely handy around the house for quick repairs. Take an old milling machine cutter that has seen its best days and anneal it. This will make as good a ratchet wheel as you want.

A ratchet wheel, *A*, should be keyed on the drill carrier or spindle *B*. Then bend a piece of strap iron



A home-made ratchet drill.

to a U shape as shown at *C*, and drill a hole in the end of the U-shape iron, so it will be a neat sliding fit over the spindle *B*. A hole must also be drilled in the outer end of strap iron, so that a piece of round iron or pipe can be screwed in position so as to act as a handle shown at *D*. A dog, *E*, is pivoted upon a pin, *F*, and a spring, *G*, holds the dog against the ratchet wheel, *A*. While drilling a hole the drill is fed into the work by means of a feed screw, *H*, which is provided with four pins as shown in the head of the screw, thus making it easy to feed the drill into the work. The feed screw, *H*, has a female center which fits over the center of spindle, *B*. The ratchet held in this way will be held very rigid. The spindle is made so it will take any size of drill having a No. 1 shank.

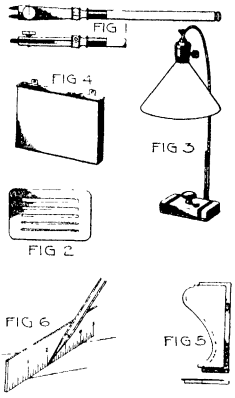
Drafting Room Kinks

By John D. Adams

ON drawings where the lettering is considerably scattered and some degree of uniformity is desired, it is quite essential that some rapid means be provided for drawing the pairs of parallel guide lines. Measuring is altogether too slow. In most drafting rooms will be found one of those rather large, obsolete, right-line pens. Cut off the points, as shown in Fig. 1. Insert two chisel-pointed leads, and tighten the screw. When adjusting the distance between the leads it is only necessary to partially loosen the screw, after which the leads may be pushed in or out. This instrument is very rapid, and requires infrequent sharpening.

Fig. 2 illustrates another method of accomplishing the same end. A piece of transparent celluloid is provided with a series of slots of different widths. Although this little device is common, it is not to be found in any of the catalogues. It is superior to Fig. 1 where the lettering must not only be uniform, but of certain standard heights.

The writer has used several excellent forms of



Drafting room kinks.

lighting fixtures for the drafting table, but none that gave more satisfaction than the little light shown in Fig. 3, which was improvised in the course of a half hour from a piece of heavy copper wire and a paper weight. On one end of the copper wire a hook is formed. The wire then curves downward toward the base, where it is bent into a rectangle the size of the paper weight. The extra length of wire is then carried upward and neatly bound to the vertical section. Two pieces of cord serve to connect the wire securely to the paper weight, and also to keep the base from scratching the table top. The electric cord in leaving the socket is fastened to the hook, from which it may be run directly to the outlet, or else down the curved copper standard and once around the knob on the paper weight. The latter is the better method. A shade of Bristol board answers every purpose, and the resulting lightness of this feature, as well as the upper works in general, renders the lamp very stable and easy to shift.

For those who have too little office space to accommodate the usual horizontal blueprint tank and yet find it necessary to make a few prints occasionally, the vertical tank shown in Fig. 4 will be convenient. This need be only an inch or two in thickness, so that the space it occupies is negligible. One or more wires running longitudinally across the top will serve to hold the prints while washing. The writer has seen a print two by three feet washed in one of the stock metal tubes used for keeping blueprint paper. These tubes are about two and a half inches in diameter and have screw tops.

In Fig. 5 is a suggestion to draftsmen who have to use special curves very frequently. A piece of transparent celluloid, which may be obtained at most stationers, is placed over the pencil outline of the desired curve, which is then marked off. The curve is then cut out with the shears and smoothed up with file or sandpaper. A piece of cardboard will serve to keep the celluloid far enough away from the paper to permit the use of the ruling pen.

There are comparatively few draftsmen who fully appreciate the possibilities of the ordinary flat machinist scale. With a little practice this form of scale may be readily handled on edge in which position spacing may be done with almost mathematical accuracy, as a sharp pencil point fits into the small grooves that mark the distances on the scale. In fact, there is probably no other method by which a point can be placed accurately and quickly.

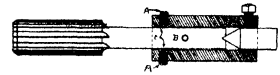
Supposing that in Fig. 6 it is desired to subdivide the space between the two parallel lines into thirteen equal parts. Simply place the scale at a suitable angle to the parallel lines so that thirteen equal divisions—in this case quarters—exactly reach from one line to the other. Run the pencil point down each quarter mark, and the spacing is done.

Floating Reamer for Lathe

By H. D. Chapman

THE accompanying engraving shows how a floating reamer can be made and the way it is used.

For very accurate work the floating reamer has come to be the standard. This style of reamer the writer has used very successfully on a lathe.



Floating reamer for lathe.

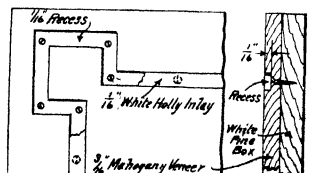
The reamer is held in a holder as shown, the holder is bored about 1/64-inch larger than the body of reamer. This is done so as to allow the reamer free movement. The reamer is held as shown against a center at the back and it has a pin through it at *B*, which prevents the reamer from turning. The hole that is drilled through the holder should provide about 1/64-inch clearance, so that the reamer can find its center while in use. There are four springs shown at *C* which are used to adjust the reamer into alinement with the work. These springs are held in position by means of set screws *A*. This reamer has now been in service for about two years and is used for reaming draw tubes for telescopes.

A Novel Method for Attaching Veneer

By R. C. D.

SOME time ago the writer had occasion to veneer a large box with mahogany. Not having the necessary facilities for glueing the veneer and clamping it in place until it was thoroughly set, as is the usual method, he proceeded to attach it as shown in the accompanying illustration. It is a simple method, and one which gave excellent results.

The mahogany was about 3/16 inch thick, and it was to be inlaid with 1/16 inch white holly. The recesses for the inlay were first cut out. The mahog-



Method of attaching veneer.

any was then placed in position on the box which was of white pine, and was firmly attached to it by means of screws which were placed at various intervals in the recesses. The heads of the screws were countersunk into the bottom of the recesses as shown. The white holly was then laid in the recesses and secured in place with glue and thus all traces of how the veneer was held in place were completely hidden.

This is a trick worth knowing and it may come in handy for a number of our craftsmen friends who have like work to do.

The Inventor's Department

Simple Patent Law; Patent Office News; Inventions New and Interesting

The British Inventor: His Decadence and the Remedy.

IN an article published in the London *Engineer* Mr. W. O. Hornsall analyses the reasons why England has fallen behind other nations as regards the evolution of useful inventions.

In its editorial columns, the *Engineer* firmly declines to agree with Mr. Hornsall in the assumption that British invention is at all in a backward state, and cites the British man-of-war. "From beginning to end," states our contemporary, "she is the product of British imagination, British thought and British skill, and it will not be denied that she contains a collection of inventions for which it would be hard to find an equal outside of an international exhibition. We are not going to attempt the impossible task of separating the details of her contents according to the nationality of thought which first inspired them, though, if we did so, the preponderance of British inventiveness would be enormous, but we shall content ourselves by pointing out that nearly every one of the million details which may be found within her walls has been thought out in British drawing-offices."

Mr Hornsall states that the attitude of the British manufacturer toward new inventions is one of apathy, coupled with extreme skepticism. The manufacturer can be induced to take up a new patent only under an agreement giving him the lion's share of the profit, while the inventor is saddled with all the risks.

"The majority of ideas cannot be put into workable shape without patient and often costly experimenting, hence an inventor with out means of his own must apply either to a capitalist or a manufacturer for assistance. The former is very chary of risking his money in such ventures, in view of the attitude of the manufacturer indicated above, and the latter, if he can be persuaded to take any interest at all in the idea stage, will suggest employing the inventor under an agreement by which he surrenders all claims to any improvements resulting from his efforts. This state of things compares unfavorably with the attitude of manufacturers towards inventions in certain other countries who now give us the lead in this line.

"In view of the epoch making inventions brought out by British enterprise during the last century, it is difficult to believe that our inventors are suffering from any lack of originality, this view being further supported by the large and increasing number of applications for letters patent. Such being the case we are driven to the conclusion that the chances of a reward, which were good enough to attract the best brains in the country thirty to fifty years ago, have now become too remote to act in this way, with the result that our manufactures have been reduced to copying the inventions of other nations. There is little room for doubt that the position is mainly governed by the attitude of the manufacturer both as regards the independent inventor and his own employees.

"It is not intended to suggest that the majority of the British firms make no recompense whatever to workpeople who bring forward valuable inventions, but the reward is generally in the form of a small increase in salary, which may, and often does, end after a short period owing to a revision of the staff appointments. Only a very few manufacturers employ experimenters whose whole duty consists in developing new products, and the chances of a small increase of salary for an uncertain period are not sufficiently attractive to induce inventive efforts in those who have been engaged for other duties; hence, if a good idea is thought of, the experienced assistant will keep it to himself until he secures a new appointment, when protection can be obtained between engagements.

"It is difficult to understand what objection there can be to paying a small royalty to a workman. It would have to be paid to an independent inventor, and, after all, the firm is placed under no permanent obligation, as the royalty ceases with the manufacture; moreover, much better terms can be arranged than would be practicable in taking up the invention of an outsider. It is only fair to state that certain enlightened firms have been very liberal with members of their staff who have brought out new inventions and such concerns have greatly benefited by this procedure, but the general rule is to give no royalties to workmen, whether engaged for experimental work or other duties."

Mr Hornsall believes that one reason for the lack of English success in the direction of new inventions is the neglect of experimental and research work by manufacturing concerns. This plan is in marked contrast to the methods pursued in Germany, where almost every large works has a number of men continually engaged in experimental and research work, no attempt being made to economize in this department, even during periods of depression.

"Often the cost of manufacture is entirely ignored, but it is obviously useless to protect a device which cannot be made for a price at which it is likely to sell.

"It would appear that an inventor if he is not an expert in the industry to which his idea applies, would often be well advised in consulting some one whose knowledge and experience would enable him to say whether the invention was likely to prove successful, and this course should be pursued before any money is spent upon taking out a patent. It will no doubt be contended that by such procedure the inventor risks having his idea taken from him for the use of some one else. If, however, care is exercised in the selection of an expert, this risk should be infinitesimal, and in the case of a useless invention the outlay upon patent fees, experiments, models and attempts to sell, are saved.

"Then again, expert knowledge is necessary for the perfecting of an invention before any attempt is made to place it upon the market, and if the inventor does not possess such knowledge he should certainly seek assistance.

"Many good inventions have failed because they have been offered to manufacturers in an imperfect state, backed up by inefficient designs and carelessly constructed models. The drawings of the invention, and the workmanship of the model, are most important when it is desired to sell a patent. A number of mechanical inventions have made a market for themselves without possession any merit whatever, excepting they have been well designed and made while others, with novel and useful features of considerable value, have failed to receive recognition owing to the careless way in which they have been put forward."

Notes for Inventors

A New Way of Hanging Clothes.—A city dweller once built his garage on the back of his home lot, shortening his yard and causing the women folks to complain of lacking space to hang the family wash. "Oh!" he said, "I'll fix that." He ran two small iron pipes, which had formed parts of an awning frame, lengthwise along and supported from the side fences by brackets which spaced the piping away from the fences. Then the clothes line was laced from side to side of the yard around the opposite pipes. When a row of wash was hung, it could be pushed along close to the preceding row, so that the capacity of the yard was equal to, if not greater than, that of the entire original yard when hung in the usual manner.

A Perpetual Motion Inventor and His Practical Suggestion.—Misdirected effort is frequently found in the pursuit of inventions, and we read of the death a short while ago of a Baltimore inventor eighty-eight years of age who is said to have spent fifty-five years of his long life seeking perpetual motion. At the same time we read of the old man's evidencing his natural and developed inventive ability by suggesting to a relative, as a wedding present, a reaping invention which is reported to have realized one million dollars or more. If this be true, his inventive talents can hardly be said to have been given him in vain.

A Parsons Turbine Gearing.—In a patent, No. 997,635, Charles Algernon Parsons of Newcastle upon Tyne, England, provides for the running of turbine elements at their most economical speed independently of the speed of the propeller shafts. He does this by combining, in the turbine installation, one or more propeller shafts with a plurality of other shafts and gearing between said shafts, together with turbine elements some of which are reversing turbine elements distributed over all the shafts, all arranged to secure the economical speed of the turbine elements.

Recent Patents for Treatment of Refractory Material. The treatment of refractory material is involved in five patents, Nos. 997,879 to 997,883, issued to the General Electric Company, assignee of Ezechiel Weintraub of Lynn, Mass., and Schenectady. The same company is assignee of patent No. 997,940, to Elihu Thomson of Swampscott, Mass., for a method of generating high temperatures, in which the vapor is generated in a conduit of relatively unrestricted bore by heating the conduit externally, accompanied by other steps in the process.

An Observation Car.—An observation car in which seats are arranged sloping upwardly from both ends of the car to a central level portion is shown in a patent, No. 997,704, to Richard M. Rodden of Montreal, Canada.

Cleaning Glass Dry.—In a patent, No. 997,447, Samuel Grimson of New York city provides a dry cleaner for glass, in which a cleansing surface of tripoli powder is held to a suitable backing by a minute coating of vaseline, which will hold the tripoli to the backing without passing through the powder.

A Parachute for Aeroplanes.—A safety attachment for aeroplanes has been patented, No. 997,454, by Grover C. Youngreen of Los Angeles, Cal., and includes a sheet of fabric which may be folded in triangular form into a vertical plane to promote lateral stability of the aeroplane, or may be folded into a horizontal plane to act as a parachute.

Another Marconi Patent.—Guglielmo Marconi of London, assignor to the Marconi Wireless Telegraph Company of America, New York, N. Y., has secured patent No. 997,808 for a transmitting apparatus for wireless telegraphy. Any reference to the transmitter is necessarily technical, but the improvement includes a battery of low resistance with moving terminals arranged so that a gap is left between them, together with pieces to bridge the gap, which bridging pieces are moved, in operation, rapidly past the gap.

A Cup Packer for Wells.—A cup packer for wells, in which a cup formed of material which softens under the influence of liquid, is combined with a spring of insufficient strength to expand the cup when dry, but can expand the cup when softened by the liquid, is presented in a patent, No. 997,721, to Charles A. Wartz of Rousseville, Pa.

A Group of Safe and Vault Patents.—Twenty-five patents, Nos. 997,771 to 997,795, inclusive, have recently issued to Taylor Iron and Steel Company, High Bridge, N. J., as assignee of Samuel W. Fish of Plainfield, N. J., for safes or vaults, safe or vault doors, safe or vault bodies, safe or vault door holding means, locking mechanism for safes or vaults, and safe or vault door holding or locking means.

S. P. C. A. Horseshoe Prize.—Early in the year the American Society for the Prevention of Cruelty to Animals instituted a prize competition for a shoe which would prevent horses from slipping. The competition was to close on June 1st, 1911. We are informed by the general manager of the society that it is unlikely that any experiments will be made or decisions arrived at until the advent of winter, as the object is to find a shoe or device that will prevent horses from slipping on icy pavements.

The Death of Samuel T. Fisher.—Mr. Samuel T. Fisher, who was Assistant Commissioner of Patents during the Cleveland administration, died in Washington, Saturday, July 22nd, 1911. Mr. Fisher was a graduate of Harvard, subsequently taking a special course at the Massachusetts Institute of Technology to fit himself for work as a surveyor, which he followed in the United States service in Colorado and then returned to Massachusetts, studied law and accepted a position as assistant examiner in the United States Patent Office rising to the assistant commissionership. Later he resigned to enter the practice of patent law which he followed with signal success up to a few months ago, when he was stricken with what proved to be his last illness.

A Waterproof Cellar.—In some sections ordinary cellars are impracticable, and James William Lane of Atlantic City, N. J., provides in a patent, No. 997,835, a waterproof cellar having a waterproof concrete floor and walls of considerable thickness with a vertical standpipe centrally on the floor and extending above the normal height of the water, in the surrounding sand, the standpipe having a filter and the standpipe being open at both ends, so that water may rise and fall freely therein.

A New Two-cycle Engine.—Charles Francis Jenkins of Washington, D. C., a well-known inventor especially in the moving picture apparatus art has recently obtained a patent No. 997,195 for a two-cycle gas engine including a longitudinal passage outside of the cylinder and within the water space of the same, one end of the passage being in open communication with the upper end of the cylinder while its lower end, in which a spark plug is located, is opened and closed by the reciprocation of the piston.

Doping Gasoline.—A real estate agent of our acquaintance uses a light runabout machine, and says he can get about eighteen to twenty-one miles out of a gallon of gasoline, but that he finds if he puts an ounce of laudanum to each five gallons of gasoline, he will increase the mileage per gallon from twenty to twenty-five per cent. Whether this is so or not—and no reason is seen why any such effect should result from the use of laudanum—it calls to our attention the use of additions to the explosive fluids for increasing their efficiency. The use of nitro compounds, such, for instance, as picric acid have been suggested. As early as 1903 Le Marc, an engineer of Brussels Belgium obtained an English patent No. 3,623 for an invention whose object was to increase the number of available calories for a given weight of fuel. He proposed an explosive fluid mixture combining 30 per cent of nitro-benzine with 70 per cent of alcohol. The fuel carried by motor cars should of course be as rich as possible in calorific energy, and a compound that can be provided for addition to the fuel charge of an automobile or motor boat should find a ready sale if it can increase the mileage per gallon or can reduce the expense without adding to the dangers of operation. While some think the development of aeronautics will be greatly affected by improvements in the fuel products, others look for material improvements in the motors, and we have seen no less an authority than Hiram Percy Maxim quoted as prophesying that "in a few years we may get a thousand horse-power within the weight we now use for ten."

RECENTLY PATENTED INVENTIONS.

These columns are open to all patentees. The notices are inserted by special arrangement with the inventors. Terms on application to the Advertising Department of the SCIENTIFIC AMERICAN.

Pertaining to Apparel.

CONVERTIBLE COLLAR.—A. M. HAZEN, New York, N. Y. This garment improvement relates particularly to a reversible collar, which may be changed from a perfect normal to a perfect military collar. The invention provides a collar to which the outer or normally visible surface of the normal collar is perfectly protected from being soiled when reversed to form the military collar.

HAT GUARD.—A. F. WILLEMAN, 70 Goldhurst Terrace, Hampstead, London, N. W., England. This invention refers to what may be termed safety pin hook and eye fastenings; that is, fastenings which are provided with a pin serving in lieu of sewing, for securing the fastening to articles of ladies' attire. The improvement consists more particularly in the method of securing a pin to each element of a fastening made from stamped up metal.

Electrical Devices.

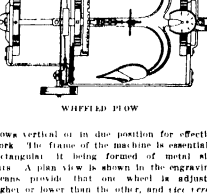
FUSE SWITCH.—A. L. WEEKES, Harpendale, Herts, England. This invention relates to fuse switches, that is, switches in which the current is caused to pass over fuses forming part thereof. Current is cut off by way of one contact spring switch blade, spring clip and fuse to the other spring clip switch blade and contact. The arrangement of the fuse member at right angles to the switch arm so that two ends of the fuse bridge the switch blades move simultaneously away from the main contacts and in a parallel way is an important feature. The blades formed as spring members enable solid main contacts to be used.

TIMER.—G. T. BROWN, New York, N. Y. This timer is for use in controlling the closing of a plurality of electric circuits in succession and relates more particularly to the type of timer commonly employed with the electric ignition system of multiple cylinder internal combustion engines. The timer is formed so that the length of time during which the contact is made will be sustained fully uniform irrespective of the speed of the engine.

Of Interest to Farmers.

COTTON CLEANER.—A. L. BREESE, Jennings, Okla. Among the principal objects in view in this case are: To provide a mechanism for cleaning cotton by pneumatically eliminating the dust and dirt therefrom; to provide means for controlling the operation of the cleaner and to provide a cleaner which is continuous in its operation.

WHEELED PLOW.—JOHN N. TINDEL, Rupert, Idaho. This invention is an improvement in reversible wheeled plows in which the frame to which the plow bodies are attached is adapted for adjustment relative to the main frame and the wheels, as required for plowing deeper or shallower and for holding the



WHEELED PLOW.

plows vertical or in due position for effective work. The frame of the machine is essentially rectangular, it being formed of metal side bars. A plan view is shown in the engraving. Means provide that one wheel is adjusted higher or lower than the other, and vice versa, whereby the level of the plow frame is preserved while one wheel runs in the furrow and the other on the unbroken land.

ANCHOR FOR WIRE FENCES.—J. RINEHART, Vanatta, Ohio. In this patent the invention is an improvement in anchors, and is designed to hold down the wire of fences between the fence posts to prevent the wire from being raised by hogs. The invention further resides in a driving block for sinking the anchor in the ground, with the tie wire in place.

INCUBATOR LAMP CHIMNEY.—G. H. LEE, Omaha, Neb. Among the principal objects which the present invention has in view are: To provide a cover for a lamp chimney constructed to control the circulation of air in connection therewith to prevent heat loss by radiation, and to provide a cover for a lamp chimney so constructed as to extinguish the said lamp when same is caused to smoke to excess.

Of General Interest.

BOX.—W. W. BAIRD, Cleveland, Ohio. An object here is to provide a blank, which may be cut in one operation with very little waste and which may be quickly set up to form a box. Another object is to provide a box with no creases to weaken the walls of the box, the box being so constructed that when it is set up the side walls cannot become dislodged, except when desired.

AUTOMATIC VALVE CLOSURE FOR WATER COCKS OR FAUCETS.—V. L. GARCIA, Buenos Aires, Argentina. The present invention relates to an automatic valve closure for water cocks or faucets, adapted to be acted upon by the pressure of the water itself. The body of the faucet consists of two parts screwed together and between these is a pure rubber disk which serves both as a valve and a means for making a tight joint between the parts of the body. Pure rubber keeps its elastic qualities without alteration within the water, as it is the oxidizing effect of dry air which deteriorates and destroys the rubber.

DRYING METHOD.—K. RETSCHER, Bielefeld, Germany. The method consists in passing the goods in two sections in opposite directions through two currents of air, each current passing over the dried departing portion of one section, then over the heater and then over the wet portion of the other section, whereby the air currents receive the preliminary heat by contact with the dried goods and are then heated by the heater, and finally come in contact with the entering wet goods to quickly dry the same prior to the latter reaching the exit portion of the drying chamber.

CLIP ATTACHMENT FOR PAPER ROLLS.—W. H. HULL, G. L. CUTLER, and A. A. BAUMAN, Gregory, S. D. By means of the attachment the operator severs any required length of the paper from the roll is facilitated so that it may be performed in about half the time required with the old attachment. Such rapidity of action is due largely to the fact that the end of the paper strip is held separated from the roll proper so that it may be conveniently and quickly severed.

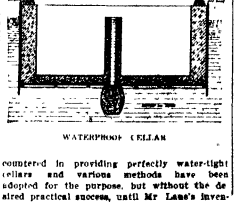
UMBRELLA CLOTH OR COVERING.—J. HYMAN, Shamarokck, N. Y. An umbrella covering made from the umbrella cloth is exceedingly serviceable and has high wearing quality, and arranged to properly shed the water, owing to the silk face formed by the silk weft threads extending outwardly to the selvage, which latter by its longitudinal ribs give a fine appearance to the umbrella.

PLATE METAL TUBING.—P. H. FURH, Kewaska, Wis. The invention provides a pliable covering material and a rigid body structure inclosed within the material and disposed to prevent the opening of the joint of the material, provides a sheet metal tube, the edges whereof are folded, and means whereby are provided with means for locking the joint to prevent the opening of the same and provides a locking member for unfolding and holding the edges of metal bent to form a tube said member being disposed within the tube.

SPARK ARRESTER.—W. T. DEPEW, St. Louis, Mich. Mr. Depew's invention is an attachment for locomotive smoke-stacks and the chimneys of stationary furnaces for the purpose of arresting sparks and cinders and preventing them to the fire-box. It is only necessary to modify the apparatus in respect to size and in some cases slightly in respect to form to adapt it to various uses.

RUG DISPLAYER.—W. J. SMITH, Tiffin, Ohio. The purpose here is to provide a device for holding rugs in such manner that without injury to the rugs, they may be presented to the inspection of the purchaser to the best advantage, and wherein the rug may be easily released from the holding means when released.

WATERPROOF CELLAR.—JAMES W. LANE, 2015 Baltic Avenue, Atlantic City, N. J. In some seashore cities and other locations where sandy soil is permeated with water to a short distance below the surface, especially in Atlantic City, N. J., much difficulty has been en-



WATERPROOF CELLAR.

countered in providing perfectly water-tight cellars and various methods have been adopted for the purpose, but without the desired practical success, until Mr. Lane's invention was put in use. In the accompanying illustration there is shown a vertical longitudinal section of a cellar constructed in accordance with the invention.

UMBRELLA OR PARASOL.—M. PRELL, New York, N. Y. In this patent, use is made of a stick, formed with telescopic sections, of which one is the handle section and contains a spring pressing the other or crown section, which latter carries the crown on which the ribs are pivoted, the runner being mounted to slide on the handle section, and being connected by braces with the ribs, the latter being connected by auxiliary braces with the handle section.

BOAT RELEASING HOOK.—J. JORDAN, Sydney, Nova Scotia, Canada. In this case the invention relates to a new and improved hook adapted to be used in supporting a life-boat or the like, which may be attached to the boat proper or to tackle, and which is adapted to automatically release the boat from the supporting members by the simple movement of a catch.

LIFE BELT.—F. JONATA, New York, N. Y. The invention relates generally to life belts and more particularly it involves an improved construction of simple form, the structure of which embodies the use of suitable material, such as canvas, having a plurality of ribs positioned at various points therein, one end of the belt being provided with a suitable valve whereby air may be emitted or exhausted from the belt.

EMBOSSING PRESS.—A. E. STIGBERG, New York, N. Y. The invention is an improvement in hand-operated presses, more especially for printing names and addresses on paper, and has in view a press in which the dies can be readily removed and replaced by other dies and conveniently and inexpensively procured. Means provide for the impression to be made at a considerable distance from the edge of the sheet.

WATCH FOB.—H. O. BECK, Atlanta, Ga. The object of this inventor is to provide a fob of flexible material having a pocket for containing a picture, or the like, wherein the picture is hidden from view, but readily accessible. The fob may be constructed of leather or other material, and may be stamped with suitable ornamentation. The fastener for the flaps is the usual glove fastener.

LOOSE LEAF BINDER.—C. F. MCBEE, Athens, Ohio. The improvement provides a binder more especially designed for use in railroad offices, manufacturing and commercial establishments and the like, and arranged for filing and subsequently binding loose leaves of tissue paper between two covers in an inexpensive manner without it being necessary to have holes previously punched in the papers.

HARROW.—L. O. EBERN, Calumet, Mich. In the present patent the invention has reference to harrows and it has for its purpose to provide means for rotating the shaft to which knives are secured from the axle on which the wheels are mounted, and also means for raising arms to which the shaft is journaled, the arms being pivoted to the axle.

Hardware and Tools.

NUT LOCK.—J. B. FUNKHOUSER, New Brighton, Pa. This invention is an improvement in that class of nut locks in which a washer is used in connection with a washer in such manner as to engage the side of a nut and thus prevent its rotation. The locking device is so constructed and applied as to connect with the washer and the nut as to lock both.

DIAL LEVEL.—J. O. ORTMAN, Hancock, Mich. An object of this inventor is to provide a folding level in which the usual tube of liquid having a bubble as an indicator is dispensed with, forming a stronger and more durable level and having an indicator that will respond more quickly to variations in level, and will show more clearly and closely the amount of variation.

SYSTEM OF LAYING OUT STAIR RAILS.—C. C. GRANT, Red Deer, Alberta, Canada.—This invention relates to systems for laying out stair rails and the like, for use by carpenters, builders and others, and relates more particularly to a system including in combination, means for holding the work, and a marker adapted to engage the work, and movable in a plurality of directions to permit the laying out upon the work of the outlines of the stair rail.

HINGE ADJUSTING DEVICE.—H. C. ERNICH, Washington, D. C. An object of this inventor is to provide means for accurately adjusting the hinge, so that a door in its closed position will be in exact alignment with the sides of the casing. The device can be applied to any type of double hinge with very little trouble, and by its means the door may be brought into position through the adjusting members at any time after it is once hung, and with little effort.

LOCK.—R. FEOLA, New York, N. Y. An object in this case is to provide a simple, inexpensive and durable lock, which serves the purposes of the ordinary padlock, which, when in position, prevents the staples or eye-bolts from being filed or cut, and which renders different other unauthorized methods of opening the lock.

WIRE TWISTING TOOL.—D. A. CLAWSON, Waynesville, Ill. This tool is more especially designed for use in building wire fences, and arranged to permit twisting the vertical wire stays in between the line wires of the fence, twisting the ends of the wire stays a number of times and leaving the top and bottom line wires without requiring rotating the handle of the tool around the wire, and allowing placing of the stay wires close together.

LATCH.—O. A. KLEIN and N. S. PIRSBALL, New York, N. Y. The latch is adapted as a fastening for clothing, straps and general usage. It consists of two members, one a pocket normally open at the front, with an engaging spring overhanging the entrance of the pocket having a shoulder, the pocket having rigid sides, bottom and top walls, and the other a head constructed to lift the spring in passing into the pocket, and provided with a shoulder for automatically engaging the shoulder of the spring when the head is seated in the pocket, and means are provided that present no projections on which clothing may be accidentally caught.

STRIKING LINE.—H. K. KISO, New York, N. Y. This invention comprehends a disk-like casing in which is revolubly mounted a drum and upon this latter the line is wound. The unwinding turns the drum in one direction, and it is retracted by a spring. The casing is provided with a sector-like opening, and fitting into this opening is a hollow door through which the line is drawn, and disposed within the door is the inking apparatus.

LAWN CLEANER.—C. H. MOSHER, Salisbury Mills, N. Y. The object here is to provide side members, to which are pivoted members carrying a shaft having tube teeth and a bar having hooks, the shaft being rotated by gearing connected by the wheels supporting the side members. The pivoted members are adjustable relatively to the side members, and means are provided for holding them in adjusted positions relatively thereto.

RAZOR SHARPENER.—D. C. WILLIAMS, Arlington, Mass. This sharpener renews the edge of razor blades, and particularly that type known as safety blades, and used in such safety razors as the "Gillette." It will automatically sharpen simultaneously a plurality of edges of a blade. The device will also alternately sharpen the opposite edges of a blade in a continuous manner.

SHAVING SET.—J. W. HAWKINS, Passaic, N. J. The set contains in very compact form one or more ordinary razors, a strop, brush and soap, the arrangement being such that the strop can be conveniently placed in a stretched position above the casing for containing the enumerated articles. For the purpose mentioned the casing is made in two parts hinged together at adjacent ends, and the strop is supported at its ends on brackets carried by the casing parts.

FIRE EXTINGUISHER.—W. S. KELLOGG and C. E. SCOTT, Elizabeth, N. J. The invention comprehends more particularly means for liberating the acid at a point some distance below the surface of the alkaline liquid, in order to insure thorough and quick admixture of the acid and the alkaline liquid. The operator may cause the extinguisher to send forth either a liquid or a gas, and to direct the same, upwardly or downwardly.

Heating and Lighting.

FEED WATER REGULATOR.—C. O. BERGMARK, Chicago, Ill. The object of the inventor is to provide a new and improved regulator for use on steam boilers to regulate the flow of the feed water automatically, with a view of maintaining the feed water at an approximately uniform level, and to allow of filling the boiler beyond the normal level whenever desired.

APPARATUS FOR BURNING HYDROCARBON FUELS.—B. L. WORTHEN, Tucson, Ariz. The more particular purpose in this instance is to introduce finely comminuted carbonaceous material into a pre-existing flame, and to supply air or its equivalent at the point of contact between the comminuted material and the flame, so as to insure perfect combustion, economy of materials, and a high degree of heat.

FUSE LIGHTER.—H. W. FULLER, Globe, Ariz. This device is for use in igniting a fuse or fuses under water. It is designed for use especially with those fuses that are designed to explode charges in running operations. Many times excavated portions are up with water, so that it is often hard to explode the charges since the ends of the fuses become wet and therefore do not ignite, even though the outside of the fuse is protected with a waterproof covering.

Household Utilities.

FOLDABLE BED BOLSTER.—F. HANSEN, and J. ADAMS, New York, N. Y. This bolster is sanitary, and is arranged to permit convenient and quick adjustment and to allow ready folding of the parts for cleaning or storing purposes. For this purpose use is made of a tubular fabric cover, stretched over bands adjustably held apart by a rod extending through the cover and seated in sockets surrounding in said bands.

ATTACHING DEVICE FOR CURTAIN STRETCHERS.—J. O. SOMMERFIELD, Chicago, Ill.

The invention has reference more particularly to a device which comprises a base adapted to be movably carried by a suitable part of the frame of the stretchers, an upwardly projecting holder adapted to engage the curtain or other article stretched upon the frame, and a guard adjacent to the holder.

PERCOLATOR.—J. J. O'MARA, New York, N. Y. This percolator comprises a main pot, a heating chamber having an opening within the pot, a percolating tube, a container for the coffee from which the infusion is to be made, and arranged to have the percolating tube discharge over the material therein, and a connection for removably associating the tube and the heating chamber, this connection forming a tortuous passage connecting the tube and the chamber with the main pot.

RECEPTACLE FOR CONDENSED MILK CANS.—W. L. KING, Pittsburg, Pa. The aim of this invention is to provide a receptacle in which may be disposed a can, a lid having an opening being provided for covering the receptacle and having a spout adapted to be disposed over the spout of the receptacle. Means provide for covering the space between the periphery of the condensed milk can and the inner wall of the receptacle, and for holding the lid in place.

WINDOW FASTENER.—G. W STEIN, Chicago, Ill. In the present patent the invention has reference to means for fastening windows by a locking mechanism, and an object is the provision of a fastening device to be used for holding one sash in a fixed position with relation to the other which may be readily adjusted to permit the free movement of either sash.

WINDOW VENTILATOR AND FLY ESCAPE.—G. W STEIN, Chicago, Ill. The ventilator may be brought into instant use at any time without the necessity of raising or lowering the window sash. It will permit a circulation of air therethrough, but at the same time prevent snow or rain from blowing in through the openings. It may be readily attached to any window.

Machines and Mechanical Devices.

CHOCKING MECHANISM FOR COMPRESSES.—W. HILL, Alexandria, La. The principal object which the present invention has in view is to provide an efficient and rapid means for the adjustment and operation the rapid acting platen of a compress, the means being adapted for arrangement relative to the said rapid acting platen in any position to which the same is adjusted.

MAGAZINE FOR TYPE SETTING MACHINES.—J. J. HUMMEL, Spokane, Wash. This invention provides a magazine for holding type in position for delivery to a type setting machine having a feeding attachment adapted to mechanically deliver the type to the machine; provides for the said type graduated to the thickness of type being handled; provides for attaching the magazine to the font frame of a type setting machine; and provides a magazine to be rapidly and readily placed in position for refilling.

OPERATING KEYBOARD FOR TYPE SETTING MACHINES.—J. J. HUMMEL, Spokane, Wash. This invention provides a mechanism for rapidly operating the keys of a keyboard to arrest the carriers in their flight and in a manner to provide against conflict in selection of the type; provides a locking mechanism whereby the mentioned conflict is avoided; provides a mechanism arranged to produce a necessary interval of time between operations of the keys in harmony with the operation of the above mentioned rotary track mechanism supporting the type carriers.

FLYING MACHINE.—O. A. FENN, New York, N. Y. This invention is of the aeroplane type. An object is to provide a machine with a plurality of supporting planes, offset from one another out of vertical—alignment. Means provide for directing the vertical travel of the machine, and a universal rudder for further controlling the direction of travel of the machine. Supporting planes are provided capable of being distorted into parachute form.

POST MOLDING MACHINE.—A. W. SWOOKEN, Lonidas, Mich. The object here is to provide a machine for molding fence posts and the like, preferably of concrete, and adapted to mold posts of various shapes, depending entirely upon the form of mold used. The invention comprehends among its features, a self-brought tamping plunger for suitably tamping the concrete in the mold and pressing it into a shape similar to the form of the mold.

COMBINED ELEVATING AND FRUIT CLEANING MACHINE.—A. J. NYE, St. Petersburg, Fla. An object of this inventor is to provide a device by which fruit such as oranges, grapefruit, lemons, etc., may be thoroughly cleaned from scale, dirt or other impurities while being elevated from a lower to a higher floor. The fruit is held positively in position while being cleaned by a series of spring actuated brushes which conform to the contour of the fruit.

VALVES.—F. J. MEYER, Yonkers, N. Y. The object of Mr. Meyer's invention is to provide a combined improved valve for use with high or low pressure steam supply, and arranged to insure long life of the valve, to prolong the period of repairing or rewashering the valves, and to prevent waste of water by leakage.

TRIPLET BUCKET LADDER DREDGE.—M. S. GODIT, West Wareham, Mass. This invention pertains to a dredge of the endless bucket type, in which a plurality of individual bucket ladders are provided. An object is to provide a dredge with a plurality of ladders having endless bucket systems thereon, one of which operates in advance of the others in such manner that a more efficient operation of the device is obtained.

NUTCRACKING MACHINE.—B. W. ELDER, San Antonio, Texas. The invention refers more particularly to a machine which comprises a pair of movable members for actuating the same, and a cutter, the members having means for holding between them a nut, and serving to carry the same into engagement with and past the cutter to effect severing of the shell from the nut. Mr Elder has invented another nut cracking machine for cracking shells of different kinds of nuts, and it refers more particularly to a machine which comprises a pair of relatively movable cutter heads each having a cutter, and means for limiting the penetration of the cutters to prevent injury to the kernels of the nuts.

SOUND REPRODUCER AND RECORDER.—W. A. CHAPMAN, Smithville, Ark. The invention is particularly useful in connection with talking machines employing disk or other types of records upon which sounds are recorded in the form of grooves, and in which diaphragms are used to reproduce the sounds from the grooves, or to form the grooves upon blank records.

STRAIGHTENING MACHINE.—J. S. BACHMAN and C. E. MCLIN, Rome, Ga. The object of this invention is the provision of a machine for straightening previously used bale ties and for removing lint, jute or other extraneous matter from the straightened tie which extraneous matter may adhere to the tie from previous use.

APPARATUS FOR BENDING PRINTERS' RULES.—J. A. RICHARDS, Albion, Mich. This invention is an improvement in hand-operated apparatus employed for bending printers' rules and other thin metal bars used for various other purposes, and it is particularly an improvement upon the apparatus forming the subject of Patent No. 707,744. When this machine is made of large size it may be successfully used for bending much thicker bars or rods used for various other purposes.

AUTOMATIC CLOTH MEASURING AND PRICE CALCULATING MACHINE.—R. H. SHEPPE, Big Stone Gap, H. H. EZELL, Duffield, and C. D. ALLEN, Meadowview, Va. This device measures the number of yards of cloth sold, and at the same time calculates the total cost of the same. The invention provides a device in which any quantity of cloth, within reasonable limits, can be automatically registered, and the price thereof simultaneously exposed to view, with means for automatically returning the device to its original position.

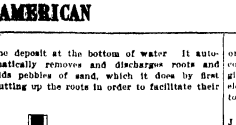
COMBINED STUMP PULLER AND STUMP PILER.—I. L. MITCHELL, Cedar Rapids, Iowa. Stump pullers of a certain type are provided with a rotary drum on which is wound a chain or rope that in practice is extended and attached to stumps or trees to be removed. The inventor has made improvements in such pullers and has combined therewith an attachment for swinging the stumps laterally out of the way and collecting or piling them in heaps.

AERIAL VESSEL.—C. O. ROWLAND, Chicago, Ill. This improvement relates to aerial vessels, more particularly to that type known as "heavier-than-air" machines, and provides a vessel adapted to navigate in the air, and sets air currents in the atmosphere being employed to control and propel the vessel in addition to driving means provided on the vessel to more easily direct the same.

ADJUSTABLE SHOCK ABSORBING FOOT.—W. MEYEROTT, Middletown, Ohio. This shock-absorbing foot is for use on typewriters, cash registers, or articles of furniture where it is desired to prevent the surface on which the articles rests from being marred, and where it is further desired to deaden the shock incident to the operating or moving of the article and deaden the sound thereon.

AERIAL NAVIGATION.—M. B. SELLERS, Baltimore, Md. The apparatus in this invention has four aeroplanes arranged in stepped form with the highest in front and each of the aeroplanes comprising two so-called wings alongside of each other with the wings of each aeroplane joined together by couplings at their meeting edges. The wings are supported and braced by struts; the frame is supported from the chassis, the latter comprising a combination of sled and wheels so arranged that when the aeroplane is acquiring initial velocity it will run on the wheels and in alighting the wheels rise out of the way, allowing the machine to come to rest on the runners.

WASHER FOR PEBBLE PHOSPHATE AND THE LIKE.—THOMAS ROBERTS, Charlotte Harbor, Fla. This washer separates pebble phosphate from sand, rocks, etc., with which it is mixed, as generally obtained from the deposit at the bottom of water. It automatically removes and discharges roots and rids pebbles of sand, which it does by first cutting up the roots in order to facilitate their



WASHER FOR PEBBLE PHOSPHATE.

expulsion over a grating. This grating admits of the passage of sand and pebbles through it to conveyers operating in a screened pocket adjacent to the screen on which they discharge. The screen in turn discharges on a second screen leading to the receiver for the pebbles, which is usually a barge. The washer is designed to be located on the upper deck of a dredge, and is shown herewith in a plan view.

SPINDLE LOCK.—M. OMALIA, Scranton, Pa. The more particular purpose here is to provide a lock for preventing the removal of a spindle, such, for instance, as is commonly employed in factory work, from its mounting, yet allowing the spindle all the freedom of motion which it now has, and also permitting the removal of the spindle when the operator sees proper to release the lock.

SELF BALANCED THREAD BOARD.—CHARLES F. WILLIAMS, Greenville, R. I. The accompanying engraving shows a view of self balanced thread boards in position on their rails. The invention relates to ring spinning frames, and the object is to provide a board arranged to permit raising or lowering it conveniently by the doffer taking hold of the

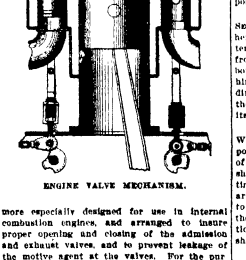


SELF BALANCED THREAD BOARD.

board at any point in the length thereof, and swinging the board up or down, the board in any one of its positions being securely locked in place. For this result, use is made of a counterbalancing lever, a link connecting the lever with the board and a locking device for holding the said lever locked in whatever position it is moved to, on the operator swinging the board into a desired position.

Prime Movers and Their Accessories.

ENGINE VALVE MECHANISM.—OSCAR LAURIN, 4860 Tenth Avenue, Borough of Manhattan, New York, N. Y. The object of this invention is to provide a valve mechanism



ENGINE VALVE MECHANISM.

more especially designed for use in internal combustion engines, and arranged to insure proper opening and closing of the admission and exhaust valves, and to prevent leakage of the motive agent at the valves. For the purpose mentioned use is made of a hollow valve for the passage of the motive agent (either live or exhaust), and the valve is adapted to engage a yieldingly mounted cap for closing or opening the hollow valve. In the accompanying engraving a clear presentation is given of the invention in a sectional side elevation of the valve mechanism as applied to internal combustion engines.

RADIATOR CAP.—C. P. ANS, Hoboken, N. J. This invention pertains to radiators, for cooling internal combustion engines. An object is to provide a cap which will condense and return to the radiator any water which may be vaporized by the heat in the radiator, and one which will return to the radiator any water which may be thrown through the vent into the cap.

POWER DEVICE.—T. A. MACDONALD, Clifton, N. J. An object of this invention is to provide a device in which a maximum power is generated from a minimum expenditure of energy. A further object is to provide a wheel or a plurality of wheels, each consisting of a number of blades of particular shape, whereby the motive fluid which is designed to drive the blades is utilized to the fullest extent.

Railways and Their Accessories.

GUIDE BRACKET OR RAIL FOR EDGE WIRE MOVABLE DOORS.—J. M. GRAY, Atlanta, Ga. It is sought in this invention to provide a construction whereby in case the door should become bound in position by the load within the freight car, or otherwise, it can be readily freed and opened, and to provide a construction which will be operative no matter in what position the car may be placed in a wreck or otherwise as it will operate with the car upside down.

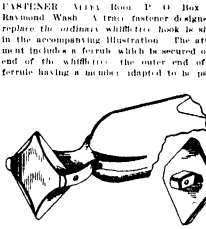
Pertaining to Recreation.

MECHANICAL TOBOGGAN SLIDE.—W. F. MANGELS, New York, N. Y. This invention refers to amusement apparatus, such as are used in pleasure resorts, parks, exhibition grounds, and other places, and its object is to provide a new and improved mechanical toboggan slide arranged to afford an exhilarating ride, and to provide means for racing a number of toboggans or sleds starting simultaneously.

FOY.—C. G. PUCKETT, North Bradick, Maine. This invention relates to toys, and more particularly to a toy consisting of a rotary member and a receiver located over it the receiver being adapted to receive sand or other granular substance which upon being released, operate the rotating member for the amusement of children.

Pertaining to Vehicles.

WHIFFLETREE HOOK AND TRACE FASTENER.—ALEX ROSS, P. O. Box 601, Raymond, Wash. A trace fastener designed to replace the ordinary whiffletree hook is shown in the accompanying illustration. The attachment includes a ferrule which is secured on an end of the whiffletree, the outer end of the ferrule having a member adapted to be passed



WHIFFLETREE HOOK AND TRACE FASTENER.

through the eye of the trace, the base of the member being narrow and its outer end widened, the widened end carrying hook projecting side members that receive between them a detachable button and between the side arms of the ferrule member there is formed also a recess which receives a stud on the inner side of the button. A removable fastening pin is passed through the stud of the button and the ferrule attachment to hold the trace in position.

BOTTOM DUMPING WAGON.—M. L. SENDERLING, Jersey City, N. J. A purpose here is to provide a vehicle for carrying materials in bulk, and which is adapted to dump from beneath and to provide a dumping scow bottom, since the bottom, which is in two hinged sections opening sidewise in opposite directions, not only constitutes a bottom for the body, but also has a carrying capacity of its own.

TIRE CONSTRUCTION.—C. N. HARRISON, Westfield, N. J. The more particular purpose of the inventor is to increase the life of the tire by giving the tire tread a desirable shape for the purpose of lessening the continual bending which the tread must ordinarily undergo. The invention further relates to clamping mechanism for holding edges of the tire far apart to give the intervening portion of the tire tread a substantially bow-shaped section.

NOTE.—Copies of any of these patents will be furnished by the SCIENTIFIC AMERICAN for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

Notes and Queries.

Kindly refer your queries on separate sheets of paper when corresponding about such matters, and write subscriptions books, etc. This will greatly facilitate answering your questions. In many cases they have to be referred to correspondents and the full name and address should be given on every sheet. No attention will be paid to unsigned queries. Full lists of correspondents are printed from time to time and will be mailed on request.

(12,909) I. L. B. writes: You seem to have an idea of heat waves which is not the one accepted by physicists. See Maxwell's theory of Heat. (Longmans, Green & Co., 1902), the lower half of page 10 he defines three modes of heat transference. Then continuing one of these modes on top page 247 he says: Hence all that we have said about the waves of light is applicable to heat radiation which is therefore a series of waves." Rearranging the sentence, we get that a series of heat waves is therefore heat radiation. Then see Preston, Theory of Heat (1904), page 56, top paragraph where he states that all matter at any temperature gives waves of heat. Follow this with page 539 at bottom. We should confine our attention to the process of radiation, which does not appear to depend in any way on the presence of matter, but which takes place through the best vacua, and through interstellar spaces." This sole statement is no original statement that a vacuum is no insulator for heat waves (i. e., radiation. Conduction and convection are eliminated as modes of heat transference as surrounding a body with a vacuum, and the radiation is made as small as possible by using a polished surface. See Preston page 526 article 259, on the radiation of polished surfaces. In regard to the second part of my criticism let me cite "Modern Electrical Theory," Campbell (Cambridge Series 1905) page 106: "And the mean kinetic energy of the molecules in virtue of their speed of agitation is proportional to the temperature of the gas on the absolute scale." Also Schuster, "Theory" by Boynton (Macmillan Company, 1904) page 42: "Two gases are at the same temperature when their molecules have the same mean kinetic energy." In neither case is any reference made to the number of collisions as having any necessary connection with the temperature. In Maxwell's Theory of Heat page 82 we find the equation

$$p = \frac{1}{3}\rho\bar{v}^2$$

v = velocity
σ = volume
p = pressure

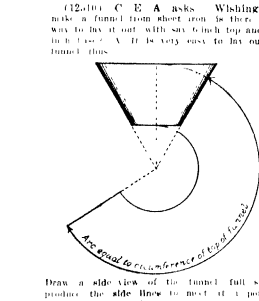
And also the statement that $p\sigma$ and $\frac{1}{3}\rho\bar{v}^2$ are proportional to absolute temperature. No term showing number of collisions of molecules is given. The number of collisions per second is given by an equation in Boynton page 50:

$$\frac{I}{T} = \frac{\sqrt{2}\,\pi\,n\,s^2\,\bar{v}}{4}$$

n = number of molecules per $c.c.$
s = one inch cross section of molecule
$\bar{v}$ = velocity of molecule
I = total volume considered
T = time between collisions
$\frac{I}{T}$ = number of collisions per second

Notice that the velocity is only one of four factors that determine the number of collisions per second so that the temperature of a gas and velocity of its molecules must be increased without increasing the number of collisions provided the other factors (for example 24) be changed in the proper ratio. The concentrates on my original statement that the number of collisions is not a necessary cause or result of a rise in temperature of a gas.

(12,910) C. E. A. asks: Wishing to make a funnel from sheet iron is there any way to find it out with say 6 inch top and 2 inch base? A. It is very easy to lay out a funnel thus



Draw a side view of the funnel full size producing the side lines to meet at a point; draw two circles from this point as a center and step off on either of the circles with a pair of dividers set to a small space a distance equal to the circumference of the funnel; then cut out the pattern.

NEW BOOKS, ETC.

THE ENGINEERING INDEX ANNUAL FOR 1910. New York: The Engineering Magazine, 1911. 8vo, 496 pp. Price, $2.

The headings under which this admirable index is based comprise civil engineering, electrical engineering, industrial economy, marine and naval engineering, mechanical engineering, mining and metallurgy, railway engineering, and street and electric railways. A specialist in any one of these branches will find a collation of references to the current literature of his subject. Two hundred and fifty publications are included, representing seventeen peoples and six languages. Every entry is accompanied by a short note defining the scope and purport of the article. This, the ninth volume, completes an index of engineering and technical literature covering twenty-six years, although the first two volumes, 1884 to 1895, are now out of print.

STORAGE BATTERIES: Their Theory, Construction, and Use. By A. E. Watson, E.E., Ph.D. Lynn, Mass.: Bubier Publishing Company, 1911. 16mo, 166 pp., illustrated. Price, $1.50.

In offering a second edition of "Storage batteries" the author endeavors to give within limited space all the essential features and advantages of the modern forms of cells. He sets forth in simple language the theory of the chemical actions involved, gives his own method of making plates tells how to set up and care for batteries, and instructs the reader as to switchboard arrangements. The lead type of cell is dealt with almost exclusively, as being the only really efficient cell on the market. The descriptions of cells have been approved by their manufacturers, so that the accuracy of each description is assured.

TO MARS AND THE MOON. By Mark Wicks. Philadelphia: J. B. Lippincott Company, 1911. 8vo, 328 pp., illustrated. Price $1.50.

The world is beginning to see that there is more romance in science and more science in romance than it has heretofore been willing to admit. Perhaps this fact is sufficient excuse for Mr. Wicks's attempt to take us to Mars in a flying machine. At any rate his pleasing narrative is a medium for the conveyance of the latest discoveries and speculations concerning Mars and its inventions, and he is to be commended for the care with which he has drawn the line between fact and fiction while sustaining at the same time the interest of both. Mr. Wicks has put himself to the trouble of constructing a number of globes reproducing the appearances of Mars at different seasons, and the flying pictures, the plates showing those globes make it easy to follow his description, theories, and arguments. Most people have extremely hazy ideas regarding the relative motions of the earth and the planets, the probable appearance of interstellar space, and the possibility of the existence of life on other worlds than our own. For this majority sugar-coated science is not without value, and the book, put in such a narrative as "To Mars on the Moon," will help them to a better understanding of our solar system and its marvelous machinery.

BEN STONE AT OAKDALE. By Morgan Scott. New York: Hurst & Co., 1911. 8vo, 316 pp., illustrated. Price, 60 cents.

Boys demand incident and action in their fiction. If the story gladdens soon boy being, so much the better. There is plenty of fun and plenty of action in Ben Stone at Oakdale. Ben the hero, is the proverbial boy with a bad name. His plucky stand against adverse circumstances and persecution forms the substance of the narrative. While adventures are encountered and prodigies performed, the probabilities have not been strained to the vanishing point the characterization is kept within the bounds of reason, and inspiration toward fair play and manliness breathes from every page.

THE EXPERT SIGN PAINTER. By A. Ashmun Kelly, Malvern, Pa. A. Ashmun Kelly, 1910. 8vo, 302 pp.

As its title implies, this is a book of reference for practical sign painters and letterers. It is not a collection of fonts and alphabets, but places before the expert workman the varying methods of other expert workmen compiled not alone from the writer's own experience, but from all the published works and current literature on the subject with which he has been able to get in touch. In the historical sketch which introduces the subject the writer makes mention of such well-known men as Benedict Arnold and James Whitcomb Riley. Arnold wielded the brush and pencil on sign-work while living in New Haven and Riley began life as a sign painter. From a general consideration of letters and lettering we pass to the tools of the trade, the pigments, and the construction of the sign board. Special requirements are treated in separate chapters, as the things necessary to be observed in church lettering, in wall signs, in lettering on oil cloth and canvas in silk and satin banner painting, and in smalts and smalting. Work on glass—gilding, pearl leaf enrichment, embossing, and imitation frosting—is given several chapters. Even the prices charged for various kinds of work are given, the office equipment and stationery are taken under advisement, and side-occupations such as glass-drilling, the manufacture of bronze powder and tinfoil, and the silvering of mirrors are dealt with in the concluding chapters of the work.

SOME SMALL HOUSES. By Walter Gray Ross. New York: Frederick Warne & Co. 8vo, 94 pp. Price, $1 net.

"Some Small Houses" was first issued in 1908. That edition having been exhausted, the opportunity has been taken to enlarge the work. There are ninety reproductions of photographs and black-and-white drawings, besides a frontispiece in color, and many of these cannot fail to interest that great proportion of educated people who, as the author truly says, have to make their homes in small houses. It is an English publication, hence the cost estimates given will not apply to this country. Aside from this drawback, however, there is no reason why the designs should not be at least helpfully suggestive to American home-builders, if not to be adopted in their entirety.

COMMERCIAL GEOGRAPHY. By Edward Van Dyke Robinson. Chicago: Rand, McNally & Co. 12mo.; 455 + 48 pp. Price, $1.25 net.

The last decade has seen the publication of a number of commercial geographies which all have more or less merit. The present volume, however, departs rather radically from its predecessors, and being published by a large map and atlas firm, the maps themselves are of the highest order. It is impossible to see how a more complete and useful book on this subject could possibly be written. The beautifully colored maps are not placed at the end of the volume or scattered through the book as inserts, but are actually printed where they belong with the text. The illustrations are numerous and are in the main well executed. The author has performed his task in a thoroughly workmanlike manner, and has produced a book which should be in the library of all persons who are interested in progress, whether they care for a commercial geography or not. The possession of this book will widen the mind of any one. Few people, for instance could tell you much about the Canal Zone. Here we find a map showing the boundary lines, the position of the great datum locks, Panama, Panama Railroad, the Culebra Cut, etc. The treatment is of course regionary. We can recommend this book as being a valuable addition to the library.

THE NEW DICTIONARY OF STATISTICS. A Complement of the Fourth Edition of Mulhall's "Dictionary of Statistics," by Augustus D. Webb, B.S.C., F.F.S. London: George Routledge & Sons, Ltd. New York: E. P. Dutton & Co. Quarto, 682 pp. Price, $7.

"Mulhall" is the great authority which is constantly cited by all statisticians. Unfortunately, however, it is out of date, so that the present volume will be warmly welcomed as a complementary volume. In our own experience we have found that the book on statistics is out of date in certain particulars before the first copy leaves the bindery. "Figures," according to the oft quoted dictum "can prove anything." As a matter of fact, they prove nothing at all. They simply record the success (or attempts to prove) things, and things are but evidences to be examined, weighed, and judged as any other kind of evidence. To this end no explanatory matter, either in the form of footnotes or in the text that may accompany the figures, should be left unread or ignored. This advice from the preface is specially good advice. The author wisely notes that the comparison of international statistics is peculiarly difficult. The expense of producing a book of this kind is so great that it is to be hoped that it will have a considerable sale. The book is very well made.

MODERN METHODS OF WATER PURIFICATION. By John Don, F.I.C., A.M.I., and John Chisholm, A.M.I. New York: Longmans, Green & Co. 1911. 8vo; 368 pp., 96 illustrations. Price, $4.20 net.

This is a review of the different processes of water purification, with a consideration of the extent to which they are justified by results. Much of the existing literature of this subject is in periodical form and in scattered Health Board reports. "Modern Methods of Water Purification" brings together the gist of these scattered papers and presents it in a readily accessible and permanent form. The sources of supply are considered in connection with the means used for the detection of pollution. Storage and the chemical changes it effects are dealt with in a succeeding chapter and the copper sulphate treatment of plant growths is explained. The chapter on the construction of reservoirs is illustrated by diagrams showing basins in this country and in England. Sand filtration and the management of sand filters is given space equal to almost a fourth of the entire volume. Mechanical filters the ozone process, water-softening and household appliances, the testing of water, and the problems of distribution are treated in the latter part of the work, which concludes with filtration constants and data, tables, and a short bibliography. Water purification is a subject of growing interest and great importance. The work in hand is timely and comprehensive.

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The New Era of Blood-transfusion

(Continued from page 125)

fastened into that one of the two grooves on the ring which happens to be nearest to the handle (See Crile method.) The artery is then drawn over the vein so its inner surface touches the cuff, and is fastened into the remaining groove. This lining of the two blood-vessels thus meet as in the Carrel suture.

Crile experimented upon hundreds of dogs before operating upon a single human being, and has been roundly abused for his pains by the anti-vivisectionists. There being obvious danger to the giver from anæmia, and danger also that the heart of the patient might be filled so full that it could no longer pump, Crile wanted to know just how much blood might be lost and received.

The heart requires a certain volume of fluid (blood) in the vessels in order to have enough to pump on. In severe hemorrhage, temporary relief is given by filling up the vessels with salt water (saline-solution, infusion, as it is called). The salt water cannot replace the blood, but it gives the heart something with which to pump, and so tides the body over the emergency. After a time, the salt-water leaves the body through the kidneys, and the patient is as badly off as before. This is not the case with transfused blood, that stays in the vessels.

There is another condition known as "shock," in which although the blood stays in the vessels, the heart has just as much difficulty to pump as though there had been a bad hemorrhage. The reason is because the shock, the injury to the nervous system causes a paralysis of the nerves known as vasomotor. The result of this paralysis is that the blood-pressure disappears just as though a severe hemorrhage had removed the blood, and Crile has shown that, also for this condition, transfusion is the best remedy we have.

A man may be so injured by machinery as to require an immediate operation, but he has lost so much blood that his remaining strength may give way; transfusion rectifies the condition by supplying a sufficient quantity of red blood-cells to combine with the oxygen of the air and give back the oxygen to the tissues. Crile says that recovery from hemorrhage is largely a problem in mechanics, as andrenalin has been added to the circulation even after death, and the heart action substituted by manual pressure—and blood-pressure thus made to rise. We all know when a man is poisoned by gas that the red coloring matter (three hundred times as greedy of carbon-monoxide as of oxygen) has been displaced. Thus the blood is destroyed, and new blood, through transfusion, furnishes a certain corrective, if not delayed too long.

Research on the Blood.

Denys in the 17th century advocated the use of animal blood in transfusion, maintaining that as the animal lives more closely to a state or nature, his blood must be purer than man's, and answered arguments against it by inquiring why the meat we eat and the milk we drink does not act deleteriously. In view of modern blood-tests, his attitude is instructive as showing what plausible fallacies may be advanced if reasoning, as such, be not corrected by experience.

In 1821, Dumas and Provost gave out the results of their studies on the chemical properties of the blood, showing that when the bloods of different species were mixed, even though the globules were of the same size but of different dimensions, animals rarely lived longer than six days. The blood of an animal with circular corpuscles injected into a bird caused the death of the bird with symptoms of violent poisoning.

In 1875, Landois showed precisely what takes place when the blood is thus mixed. The red corpuscles are dissolved by the poisoning of the protoplasm, and the hemoglobin (coloring matter) exuded from the envelope. Under the microscope, the first stage of this condition (hemolysis) shows the corpuscles beginning to swell. The injection of certain chemicals causes the same phenomenon, and hemolysis occurs on artificial heating or freezing of blood. The consequence is the breaking down of the cell-wall. This objective demonstration, as might have been expected, put a stop to the use of animal blood in transfusion.

Modern transfusion shows that while the blood of one healthy person does not poison the blood of another healthy person, the blood may acquire such power through certain diseases, since the disease may act in such manner as to change it. In this case, too, there is a dissolving of the cells by blood which, though apparently normal, in reality is not. If the sick man's blood has this property of dissolving (hemolyzing) the blood-cells of the giver, the new blood will do him no good, as it will be destroyed as rapidly as it is transfused. If by an oversight the blood of the giver has this property, the transfusion will be even more dangerous, as the new blood will destroy that already present in the patient's vessels. By testing the two bloods against each other this danger may be avoided.

Another peculiar property of the blood is what is called agglutination, known only since 1900. When the bloods of two different persons are mixed, they often have the effect of making the blood-cells clump together in tight little masses. Landsteiner showed that all human beings fall into four sharply defined classes in this regard, and that agglutination may be explained by assuming the existence of two agglutinins, of which the second group possesses one, the third group the other, the first group both, and the fourth neither. When the blood of persons belonging to any one class is mixed with the blood of a person belonging to any of the other three classes, agglutination occurs, but this is avoided if the blood test shows that the giver and receiver of the blood belong to the same class. This is a hereditary quality, and an examination of seventy-two families shows that the agglutinins follow Mendel's law.

It is evident that if blood were transfused from a person belonging to one of the classes referred to, into the vessels of a person belonging to any one of the other three classes, the clumps likely to form would cause a stopping up of the blood-vessels and thus serious trouble. Indeed Ottenberg is investigating further the phenomenon of agglutination at Columbia College and Mt. Sinai Hospital at the present time. Medical opinion is that performing the agglutination-test for transfusion may, in many cases, make all the difference between a transfusion that is successful and one that means merely a waste of human blood.

Formerly, the patient often became worse after the operation; indiscriminately taking blood from anyone willing to give it was a contributing cause. Now when members of the family are rejected, for the reasons outlined, advertisements are put in the newspapers; fifteen to twenty respondents, at that, often being rejected as unfit to serve, and the one selected whose blood has the least or no toxic action. The person who gives his blood must be strong enough to lose it and he must have no blood-disease, by which it would appear that even selling one's blood is not by any means as easy as might be supposed.

The Current Supplement

THE mounting and grouping of exhibition specimens as practised at our National Museum of Natural History, has developed into a fine art. A particularly striking group of fossil remains of the great ground-sloth has just been completed, and in the current SUPPLEMENT, No. 1857, Mr. Beasley tells us about these giants of the past, and the good work accomplished in setting up in realistic arrangement these representatives of an age long gone by.—In questions relating to social conditions it is unfortunately very difficult to arrive at thoroughly objective conclusions, independent of subjective bias, and therefore accepted by all who devote serious thought to the subject. An attempt to apply objective methods of scientific experiment to questions of labor and wages is reported on in a very interesting article by D. A. Imbert.—That the time of day varies from place to place on our globe is a fact known to every schoolboy. But with all the details of the circumstances, which determine the "true solar day," probably not very many of us are acquainted. An article contrib-

Judge the Quality of an Automobile by the Speed Indicator It Carries

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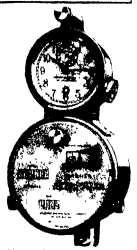
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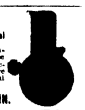
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uted by Professor F. R. Honey, of Trinity College, elucidates these points.—Lieut.-Col Hubner writes on "Combination Projectiles," a field in which recent years have brought developments exceeding some of the earlier expectations.—"There is to-day a growing tendency," says Mr S S Hough in his article on "Photography an Aid to Astronomy," "to replace the human eye at the end of the telescope by the photographic camera" The advantages thus gained, and the historical development of astro-photography are set forth by the author.—A new portable gasoline air-compressor suitable for inflating pneumatic tires is described by Mr. F C Perkins.—In an article originally published in the *Umschau*, Professor Zuntz gives an account of a new respiration calorimeter used at the Agricultural School at Berlin for investigations in the physiology of nutrition and animal work.—There is also an article by J W T Duval on a moisture tester for grain and other substances.—The second and concluding instalment of the paper by W H Dines on "Practical Applications of Meteorology to Aeronautics" appears in this issue, as does also the second instalment of Donald Murray's article on "Printing Telegraphy"

The Split-log Drag in Road-making

THE public roads bureau of the Department of Agriculture has estimated that there are 2,000,000 miles of earth roads in the United States and has suggested an inexpensive way for their improvement The split log drag is its solution of the problem, and from time to time the bureau issues bulletins in forming the farmer how to make it

The main thing needed is a dry red cedar log, although red elm and walnut are useful for the purpose, while box elder, soft maple, or even willow may be employed Oak, hickory and ash are not recommended

The log, seven to ten feet long and ten to twelve inches in diameter at the butt, is split as near the center as possible, the larger piece being used as the front of the drag and sometimes being shod with iron along the lower or cutting edge

The two slabs on edge and thirty inches apart are fastened together by stakes in such a way that when the drag is in use on one side of a road, the end of the back slab is about sixteen inches nearer the center of the drive-way than the end of the front slab This gives what is called the setback Between the heavy slabs and resting on the connecting stakes is a board on which the driver stands

A team of horses is hitched to this completed drag in such a way that the drag unloaded will follow at an angle of about forty-five degrees The teams should be driven with one horse on either side of the right hand wheel track or rut the full length of the part to be dragged, and made to return in the same manner over the other half of the roadway Such treatment will move the earth toward the center of the roadway and raise it gradually above the surrounding level

There is recommended the use of the split log drag after heavy rains, when the road should be gone over once each way, but much depends on the quality of the soil, some roads requiring frequent treatment

The method is said to be most economical

A Peculiar Well.—The attention of the Geological Survey having some time ago been called to a peculiar well in Ohio, an investigation thereof was made. The well produces both fresh and salt water through two separate pumps. The explanation proved to be quite simple Two water bearing beds, confined between layers of limestone, occur at this point, one above the water The pipe of the fresh-water pump taps the upper vein at a depth of sixteen feet The pipe of the salt-water pump touches the lower vein at a depth of thirty-five feet; and the brine, being heavier than the fresh water, does not mix with it, but remains at the bottom.

Aeronautics

The European Circuit Race.—The 1,074-mile Paris-London-Paris Circuit race, which started so disastrously, on June 18th, was finally ended on July 7th. Nine aviators out of the 41 who started succeeded in finishing. The race was won by Lieut. Conneau in his Blériot monoplane, his time being 58 hours and 38 minutes. His actual flying time was 24 hours, which corresponds to an average speed of nearly 45 miles an hour. Roland Garros was second in his Blériot monoplane with the time of 62 hours, 17 minutes, 16 2/5 seconds. Vidart, in his Deperdussin monoplane, was third, in 73 hours, 32 minutes, 57 3/5 seconds. Vedrines, in his Morane monoplane, came fourth in 86 hours, 37 minutes, 2 seconds. Gibert, on an R. E P monoplane, finished fifth, and Kimmerling, on a Sommer monoplane, sixth. Their times, respectively, were 89:42.34 3/5 and 93:10: 24 2/5. Maurice Farman biplanes, driven by Renaux and Barra, were seventh and eighth, respectively, their times being 110:14 05 2/5 and 206 21'58. The former aviator was the only one who finished the entire race carrying a passenger Tabuteau, with a Bristol (English) biplane, was the ninth and last to finish. Valentine, an Englishman, flew his Deperdussin monoplane as far as London, but abandoned the race at that point. This race was the greatest test of endurance that has ever been given the modern aeroplane Flights were made in wind, rain, and fog The greatest elimination occurred in the first stage, in which 23 machines dropped out. The second, third fourth, and fifth stages saw the dropping out of one, three, two, and two machines, respectively, while ten completed the seventh stage and arrived at London Some of the stages were flown at a speed of over 60 miles an hour

A Flight Across New York City.—On July 8th, Ladis Lewkowitz, a Russian aviator who had previously made a 6,000-foot altitude flight at Nassau Boulevard Aerodrome with his Blériot monoplane fitted with a 50-horse-power Anzani motor, ascended at that place and flew to New York He came above the East River at the Queensborough Bridge and flew up the River to Harlem at a great height. When crossing over the city at an altitude of between 8,000 and 9,000 feet, his motor stopped and the aviator was obliged to *volplane*. This he did with such good results that he crossed the Hudson River and landed in a marsh back of Leonia, some six miles away from where the motor gave out His flight and that of Atwood are the only two flights which have been made above New York since the Statue of Liberty race last October

A Record American Cross-Country Flight.—A flight somewhat in line with the great long distance races recently held abroad was made the first part of last month by Harry N Atwood, the young Boston aviator After having made numerous cross-country trips in the vicinity of the Hub, Atwood flew with his mechanic from Boston to New London, Conn.—a distance of 110 miles—in 2 hours and 10 minutes on June 30th. The trip was made without a stop and in the afternoon the young aviator took aloft the mayor of New London and flew above the Yale-Harvard Varsity boat race. At 7 o'clock the next morning, he started for New York, which city he reached in about 3¼ hours without a stop *en route*. After alighting and refilling his fuel tank at Astoria, he flew down the East River and across the sky scraper section of Manhattan Island, finally alighting with precision upon Governor's Island. On July 4th he flew the 110 miles to Atlantic City in 5¾ hours, which included several stops for gasoline He was buffeted by extremely strong head winds all the way. His machine fell in the sea and was demolished when he and Charles K. Hamilton were making an exhibition flight together at Atlantic City, but he persuaded Hamilton to lean him the latter's Burgess-Wright biplane for the balance of the flight. Hamilton had his aeroplane towed over the road from Waterbury, Conn., to Atlantic City, which was also completed in about a day, and the next morning he and Atwood resumed their

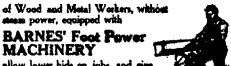


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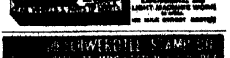
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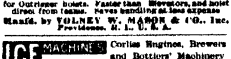


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journey toward Washington On account of the great humidity they found extreme difficulty in rising more than 150 feet and they were finally obliged to alight near Baltimore because of their inability to clear trees and buildings The following day (July 11th) Atwood and Hamilton covered the 40 miles remaining between Stemmers Run and College Park in the early morning hours without mishap Three days later he finished his 576 mile trip to Washington and alighted on the lawn of the White House, where he was greeted by President Taft In all he took two weeks in which to cover the distance whereas in the recent circuit race in England, twice this distance was covered in but 31½ hours elapsed time by Lieut Conneau in his Blériot monoplane

Science

Cranes and Herons in Surgery.—Many substances have been employed in turn for making sutures in surgery Such substances must possess peculiar properties which are not readily found Of recent years there has been recommended and used a new material of this kind the tendons of the legs of cranes and herons The tests show that these tendons are particularly well suited for surgical use They are said to form excellent ligatures and are readily absorbed after the wound has healed

The Exploration of Dutch Guiana.—The expedition that set out from Paramaribo in July, 1910, to explore the only part of Dutch Guiana not previously known to the civilized world—viz, the upper Corentyn and its tributaries—after suffering the loss of its leader Eilert de Haan, achieved the object of its labors most successfully under Lieut Kayser This expedition was the last of a series that have been working for the past 15 years, under the auspices of the Geographical Society of the Netherlands, in making a complete exploration of the colony

Color Photographs of Atmospheric Phenomena —The improvements and simplifications lately introduced by Messrs Lumière in the process of color photography were the subject of a recent address by M Léon Gimpel before the Astronomical Society of France The method of development has been greatly facilitated by the use of a green light obtained by applying "Virida paper to the lantern, while magnesium light is used in printing and an unlimited number of prints may now be easily produced Instantaneous pictures are readily taken with plates made hypersensitive according to the method of Simmnen and Thovert M Gimpel has applied these various improved methods with great success to the photography of meteorological phenomena — thunderstorms, rainbows fogs, inundations auroras sunsets etc and in the course of his lecture he threw on a screen a number of beautiful pictures of this character

Aerological Observations in Java.—Dr W van Bemmelen has published in the *Meteorologische Zeitschrift* a report on the *ballon-sonde* observations made near Batavia during the year 1910 They are the most extensive series of such observations heretofore made within the tropics, and the results are in satisfactory agreement with those obtained by Berson, in German East Africa in 1908 The stratosphere was reached several times at altitudes ranging from 15 to 18 kilometers and with temperatures ranging from —67 deg C to —83 5 deg C the latter being the lowest temperature recorded, and with the exception of Berson's reading of —83 9 deg C, the lowest ever observed in the atmosphere Such readings are however, uncertain to the extent of some degrees at the great altitudes in question. The average thickness of the westerly monsoon wind was found to be 5 5 kilometers Many difficulties in the technique of the observations were only partially overcome, but there is every reason to hope that the excellent work in aerology now being carried on by the Dutch observers in Java will in a few years fill the serious gap that has heretofore existed in our knowledge of the upper air, due to the neglect of this class of investigations within the tropics.

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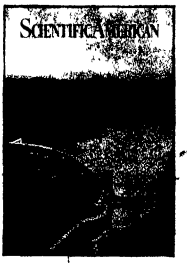
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Ex Chief Forester the Hon Gifford Pinchot, whose earnest fight for the preservation of the coal lands of Alaska has led to a favorable decision of the Land Office, which greatly strengthened the cause of conservation, will open the number with an article on the Conservation of our Forests

The Director and Chief Engineer of the Reclamation Service, F H Newell, will write a general article on the past work and future plans of the Reclamation Service

The Director of the Bureau of Mines, Dr Joseph A Holmes, will show that the waste of our supplies of coal is due not merely to careless and extravagant management in the mining of the coal, but also and very largely to methods in burning the fuel.

Dr David T Day, of the United States Geological Survey, will prove, in an article on the conservation of oil and gas, that, as with coal, so with oil and gas, it is possible to effect large economies by judicious management in the oil and natural gas fields and by the use of improved appliances in burning these fuels either for light or power purposes

Dr Hugh M Smith, Deputy Commissioner of Fisheries, will contribute an article on the Conservation of Fish, Oysters, etc., and Seals Conservation is a word to which we are liable to give too restricted an application.

In addition to the above articles, the August 12th number will contain the usual Editorial, Aviation, and other departments.

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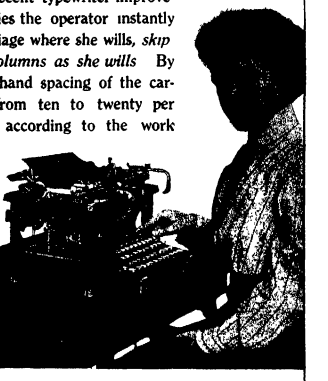
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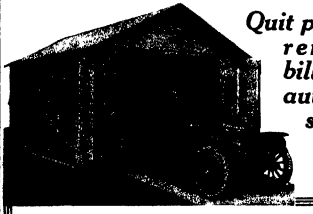
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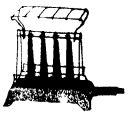
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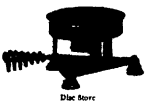
Town State

Name of your car Model No


Radiant Toaster with rack


Electric Samovar

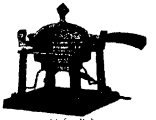

Double Disc Stove

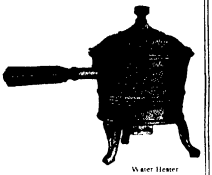

Disc Stove


Cafion Percolator

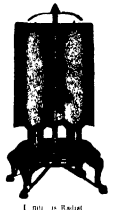

Four Quart Tea Kettle

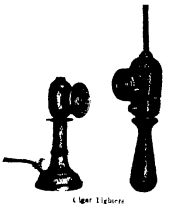

Flat Iron on stand

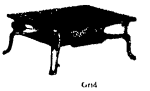

Chafing Dish


Water Heater


Air Heater

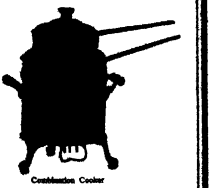

Toaster in Relief


Cigar Lighters


Grid


Frying Pan


Broiler

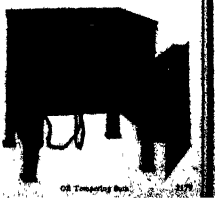

Combination Cooker


Domestic Range


Combination Oven and Broiler


Soldering Irons


Glue Pot


Oil Tempering Bath

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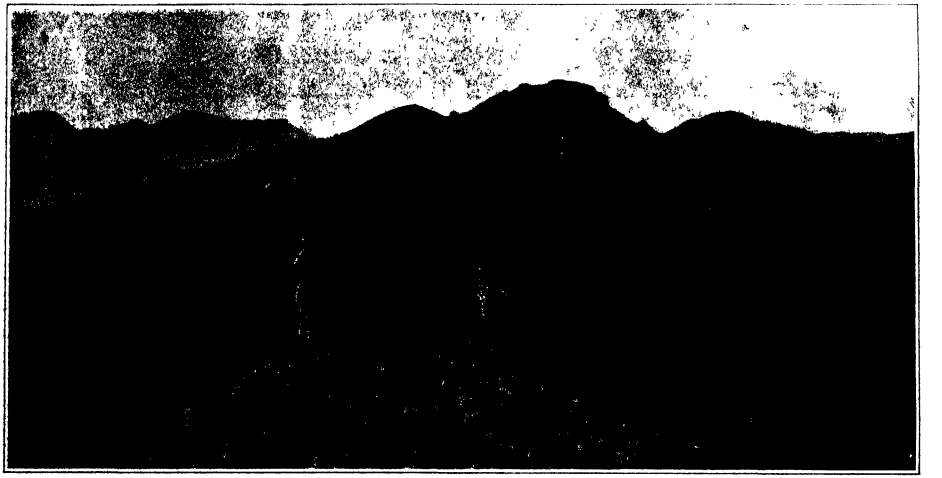
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Lookout station for forest fires in a national forest.

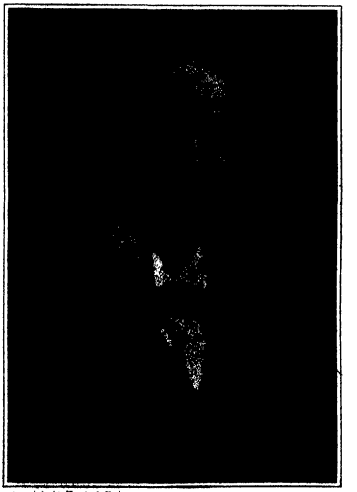
The Conservation of the Forests

A National Duty to Protect the 80 Per Cent of Standing Timber Now in Private Hands

By the Hon. Gifford Pinchot, Ex-Chief Forester

FOUR-FIFTHS of the timber in the United States is in private hands. Its preservation depends absolutely upon what the owners choose to do with it. The owner of any part of it may allow his trees to stand uncut or he may cut them under the prevailing method of destructive lumbering so that a new forest will not replace the old or he may consider his timber land as a permanent factory of wood and apply the principles of forestry. This last is what the public welfare requires that he should do but less than two per cent of the privately held timber lands of the United States are now being conservatively handled. With the threat of a timber famine so clearly before us that no man can deny the danger we are treating four-fifths of our timber in the way best calculated to bring on that famine with the least possible delay and in the most aggravated form.

It is by no means wholly the fault of private timber land owners that they do not practise forestry. To practice forestry is to engage in a manufacturing business, the product of which is wood. Now no manufacturing business can succeed unless the products of the factory will bring more in the market than they cost to produce. This is not generally true to-day of the product of the forests. The enormous accumulation of raw material (standing timber) which cost us of this generation nothing to grow in the first place, is the chief reason why the finished product (lumber, etc.) sells to-day in the United States for less than it would cost to grow, harvest, and manufacture it. This is not true in France, Germany or other countries where forestry is practised. Under the laws and economic conditions which there obtain, a timber land owner who grows wood for the market makes a reasonable interest on his money.



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Hon. Gifford Pinchot, ex-chief forester

Forestry like any other industry must become financially attractive before business men will take it up and several basic conditions must be supplied before it can become so. For example there must be a reasonable security against forest fires. As long as there is excessive danger that the investment may go up in smoke the attractiveness of a long time investment in growing wood must be very seriously reduced. There must be reasonable taxation under which there will be a fair chance to make the business pay. The land upon which the trees grow should be taxed annually but the growing forest crop itself should be taxed only when it is ripe for cutting. Other crops like corn pay but one tax before harvest. Under present methods of taxation the timber crop may pay fifty or one hundred.

There must be fairly uniform conditions imposed upon all competitors in the same market. While the difference in cost between conservative lumbering and ordinary destructive lumbering is but small it is often sufficient to give one of two competitors control over a market to which both are seeking. Thus if a State should require its lumbermen to burn their slashings protect young growth and generally to keep their forests in productive condition while the State which imposed such conditions would be at a great permanent advantage the lumbermen who were obliged to practise them would be at a slight and temporary disadvantage as compared with those of a neighboring State which did not require these precautions.

Since we must have timber it is clear that

(Continued on page 95)

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The purpose of this journal is to record accurately and in simple terms, the world's progress in scientific knowledge and industrial achievement. It seeks to present this information in a form so readable and readily understood, as to set forth and emphasize the inherent charm and fascination of science.

The Sin of National Improvidence

AMONG the many questions of national significance which have recently been brought to the public attention, there are few which compare in importance with that of conservation.

Not many thoughtful Americans will deny that extravagance is one of our distinctive national faults. At the first thought it may seem strange that the nation which has sprung from the thrifty settlers who founded Plymouth and Jamestown and were schooled in the rough adversities of an unusually strenuous pioneer life should have developed that very improvidence which the circumstances surrounding the life of the early settlers strictly forbade. Not alone in the beginnings of the nation, but for many a decade of its early existence, the conditions of life were exceedingly hard. Never surely did a race of men so literally earn its bread by the sweat of its brow as those resolute pioneers who had to coax the means of life from the rock encumbered hills and valleys of New England or endure the prodigious toil of clearing away primeval forests before they could lay bare a patch of arable land from which to raise the food and feed for man and beast.

It was in later years when the van of pioneer conquest had been pushed out into the rich and unobstructed prairie lands of the West that the American people began to realize with what lavish abundance nature stood ready to pour forth her treasures. When the cattle multiplied upon a thousand hills and the crops burst forth in luxurious abundance from the virgin soil, the pressing need for careful husbandry of resources was no longer felt. Hence it has come about that nature herself is largely responsible for that later extravagance which led the American people to squander resources which they have come to regard and speak of as practically inexhaustible.

Unfortunately the habits learned on the farm have been carried into those great industrial activities whose magnitude is one of the wonders of our modern life. If the riches of the soil were inexhaustible so also seemed to be those of the forest of the mine and of the rivers and lakes and seas with their teeming millions. Hence it has come about that in our effort to gather only the riches which are immediately and easily accessible we have been using up nature's storehouse of raw material ruthlessly destroying or letting go to waste thousands of square miles of forest and millions of tons of coal and precious minerals. Year after year crops have been sown upon the once virgin lands until in sheer exhaustion they have refused to render the plenteous yield of former years or even to yield any crops whatsoever—at least until the husbandman shall have restored some portion of those nutritive elements which are necessary to germination, growth and full fruition.

We have all heard and read a great deal during the past few years about this subject of conservation but it is a question whether many people have any just conception of how great has been the wicked waste of the past and how pressing is the need for future economy. The present issue of the SCIENTIFIC AMERICAN is published in the hope that it may put this whole question in its true light and show exactly what are the present conditions and what are the methods which have been pursued by the Federal Government in the effort to repair the damage which has been done, and properly conserve those natural resources upon which not only the prosperity, but the very life of the nation depends. The articles are written by men who, because of their position at the heads of the several departments which are devoted to conservation, are possessed of a full knowledge of the facts and are qualified to state the case with authority. The conservation number is issued in the belief that it will not only answer a thousand questions which have arisen in the mind of the American public, but will also make clear the necessity for a most earnest and intelligent co-operation with the government in this great national work.

The Hand That Wrecks the Cradle

IN a recent editorial in these columns, we spoke of the work which the modern eugenist is doing to arouse the public conscience not only to the possibilities of improving the human race by proper selection of parent types, but to the far more vital matter of mere self preservation. We called attention to Pearson's statement that 25 per cent of the present generation is producing 50 per cent of the next, that imbeciles, paupers, criminals and defectives were reproducing faster than manufacturers, merchants, lawyers and physicians, that, in a word, if the present form of society is to continue, something must be done to prevent the perpetuation of defective classes. To those readers who may take more than a casual interest in the subject, we commend the reading of Prof. William E. Kellicott's Social Direction of Human Evolution, a book which presents in a popular and yet authoritative manner the dangers that beset society.

That these dangers are not mere dreams, that heredity does play the major part in the prevention of desirable and undesirable classes alike, is only too easily demonstrated in order to drive home the necessity of a careful study of human heredity. We have only to cite Poellmann's study of a family established by two daughters of a woman drunkard, who in five or six generations produced all told 834 descendants of whom over 700 were professional beggars, inmates of almshouses, criminals and incompetents of various degrees, and to contrast with that degenerate family the 1,394 descendants of Jonathan Edwards, most of whom occupied distinguished positions in educational institutions, in the diplomatic service, in political life, in commercial affairs, and in literature.

Environment plays but a small part in this process of conscious race improvement. Free public libraries, clean houses, modern sanitation cannot correct bad blood. Slums, sweatshops and dirt are bad, not because they breed criminals but because they may kill off classes which, if nourished, might become strong and healthy stocks. What is wanted is a more painstaking and scientific study of the germ plasm that develops a healthy or unhealthy strain, rather than more asylums and prisons for the correction and punishment of offenders. A philanthropist who will wisely donate to that cause the funds which would otherwise find their way to the coffers of charitable institutions should earn everlasting fame. Greater than any political issue greater than the building of more universities and libraries, greater even than the abolition of standing armies is any movement which has for its object the direct improvement of the human race.

The sociologist has had his day. His statistics of people who are ill fed and ill housed, can serve no other purpose than that of indicating the need of better accommodations for the poorer classes in the effort to uplift them. It is to the biologist to whom society must turn—the man who can definitely point out why this or that strain is undesirable, why this family should not be married into, because of its questionable ancestry, why that stock is desirable because from it there had sprung men and women of genius.

Able work in this direction is now being done in England under the guidance of Prof. Karl Pearson of the Eugenics Laboratory of the University of London, and in America by the Committee on Eugenics of the American Breeders Association, of Cold Spring Harbor, New York. Only a beginning has been made, but a beginning that has shown that behind the phrase "race suicide" which was bandied about a few years ago, there looms a danger far greater than most of us realize. It is becoming increasingly evident that good blood means not simply descent from an aristocratic race, but descent from a race physically and mentally and morally strong.

When we consider that, according to the latest available census reports, there are among our 90,000,000 people at least 200,000 who are insane and feeble minded, 100,000 who are blind, 100,000 who are blind and deaf and dumb; 80,000 who are paupers in institutions, two-thirds of whom have children physically or mentally deficient, 100,000 prisoners, several hundred thousand more who ought to be prisoners, 25,000 juvenile delinquents in institutions, and 2,000,000 who are in hospitals, dispensaries, and homes of various kinds, and lastly when we consider that this rough total of nearly 3,000,000 defectives is capable of transmitting its tainted protoplasm to the next generation, there is indeed room for the new science of race improvement, and room, too above every asylum and prison portal, for Rentoul's epigrammatic utterance:

The hand that wrecks the cradle wrecks the nation.

A Chemical Solution of the Potash Problem

IT is a most humiliating fact that America must buy all her potassium salts from Germany—humiliating because they are absolutely necessary in renewing the fertility of our soils. Our farmers paid the Fatherland $8,000,000 last year for this one element, importing 160,000 tons of potassium chloride as well as large quantities of potassium sulphate.

Germany is very fortunate in possessing the wonderful Stassfurt deposits of mixed salts, for she has practically a monopoly of the potassium market of the world. Their government has recently given official sanction to an effort of a German trust to put up the price, although the stuff is cheaply mined. Here in America we have enormous deposits of phosphate rock and from various sources such as stockyards, Chili saltpeter, the air, etc., are assured unlimited nitrogen, but our crops demand, in addition to phosphorus and nitrogen, the third element potassium. In spite of the fact that we send $8,000,000 a year out of the country for potassium, we have enormous quantities of it at home in feldspar rock. The slow weathering of this rock makes some of it available for plant use in soluble form, and our unfertilized soils owe much to this fact. Heavy cropping, however, removes this necessary element faster than Nature prepares it in suitable form for plant use, and so arises the need of fertilizer to make good the loss.

The facts we must face then are these. Potassium chloride is quickly taken up by crops, but feldspar is too slowly available to maintain the fertility of the soil. Therefore our American problem is to make potassium chloride from our abundant feldspar by chemical means. When that is done cheaply we may snap our fingers at Germany for we will have all our plant food at home. Even if such a process could not quite compete with the German salts at present prices the fact that we were prepared if needs must, to make our own potassium chloride would be a wholesome restraint on exorbitant price raising. It is encouraging to every patriot to learn that the chemistry of this much-desired process has been fairly well developed. By heating finely ground feldspar with calcium chloride (a cheap by product of soda making) and some limestone the potassium can be extracted as the soluble potassium chloride. The residue is suitable material to calcine further into cement. The cost at present is much too high, but the sale of the cement would reduce this. One ton of feldspar rock may yield 190 pounds of potassium chloride worth $4.50 and five or six barrels of cement worth as much more. In making our annual allowance for this fertilizer we would throw on the market 7,000,000 barrels of cement—at present we use 65,000,000.

The experts of the Tariff Board urge the appointment of a national commission of chemists, geologists, engineers and business men to work out the problem on a scientific and economic basis. There is more to it than chemistry alone. Not the least factor is the location of raw materials and transportation difficulties. We owe it to our economic independence to attack this question, not from individual business motives, but from motives of the purest patriotism.

Science for Its Own Sake

SIR JAMES DEWAR recently pointed out that the whole cost of a century's research of experiments at the Royal Institution has been only about $600,000. What an insignificant sum to pay for the benefits mankind had received from the splendid investigations of Young, Davy, Faraday, Tyndall, Dewar himself, and others, comments the London *Times*. Yet most of the labors of these men were carried out *honoris causa*, and not for immediate material benefit.

(Concluded from page 148.)

the duty to surround the industry of growing wood with such conditions as will make it attractive rests squarely upon the people of the United States. The penalty for shirking this duty is a famine of one of the three great raw materials: coal, iron, and wood.

The people, then, have obviously shirked some part of their duty by failing to make forestry easily practicable. The lumbermen of the United States, it is true, have received from the government more practical help toward the introduction of forestry than has ever been offered to the lumbermen of any other country. Information of all kinds, co-operation, and practical examples have all been supplied plentifully and well. The United States Forest Service has given encouragement and assistance to the lumber fraternity to a degree wholly without example in any other country.

As a nation, we have neglected to provide the conditions necessary for all this help to have its most useful effect, and the conditions for practical forestry created under our laws leave much to be desired. Still the government has been most generous to the lumbermen in very many respects. Thus under the land laws, which have been bad, and their administration, which has been worse, the lumbermen have acquired timber land very easily, and a great concentration of timber ownership has been allowed to grow up. According to the official figures of the Commissioner of Corporations one hundred and ninety-five owners now control forty per cent of the standing timber of the United States. Three corporations, the Weyerhaeuser Timber Company, the Southern Pacific Company, and the Northern Pacific Railway Company, with their subsidiary companies, have nearly eleven per cent of all our privately owned forests. Less than half a century ago, the government owned not less than three-fourths of the standing timber in the United States. To-day, only one-fifth of all standing timber is publicly owned, while four-fifths have passed into private ownership, together with the land upon which this timber stands.

The men who hold this land own it in fee simple. It is useless to expect that they will handle it in such a way as to reduce the amount of concentration. The whole trend of our commercial development is toward great combinations of property in all the fields of industry. It is worse than useless to imagine that the old days of unrestricted competition can be restored by any legal devices whatsoever, even if it were desirable to do so. The remedy for evils of this kind is not unrestricted competition, which it is perfectly obvious can never return, but government control and regulation of combinations, concentrations, and monopolies. Forestry is of such a nature that unrestricted competition between the owners of timber lands leads not to forest protection but to destruction and waste. Of all concentrations which exist, there is none in which government regulation is more essentially and immediately necessary than in the concentration of standing timber.

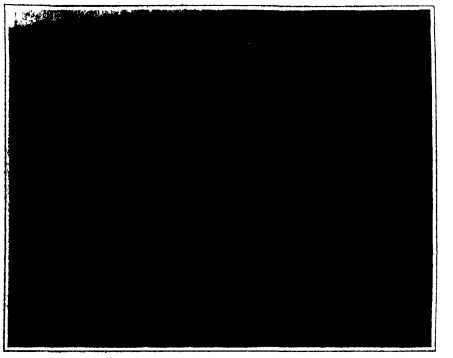
Of late years lumbermen and foresters have been most friendly. The foresters have been listened to, encouraged, and assisted by the lumbermen, whose response to the foresters has been in many ways most gratifying. They have done everything that could have been expected of them, except to practise forestry. They profess themselves desirous of doing so. It is of the first importance to the nation that they should, and the time to begin is at once.

The great interstate concentration of timber land ownership has made clear the duty of the nation to interfere for the protection of the legitimate interests of us all, lumbermen included. Since the nation owns but a small fraction of the standing timber, and since the wise handling of all of that timber is essential for the future welfare of the country, there remains nothing for the people to do but to accept the situation and regulate the handling of private forest land.

There is nothing revolutionary in such a doctrine. The Swiss, a people far more democratic than ourselves, have long ago adopted it, and the Federal Government protects and regulates the forests necessary for the general welfare. In the Republic of France, this doctrine is one of the fundamental conceptions of government. There is obviously no more reason why an individual in the United States should be allowed to handle his own forests in a way to injure the public welfare than why he should be allowed to use his own property in a city so as to endanger the public health.

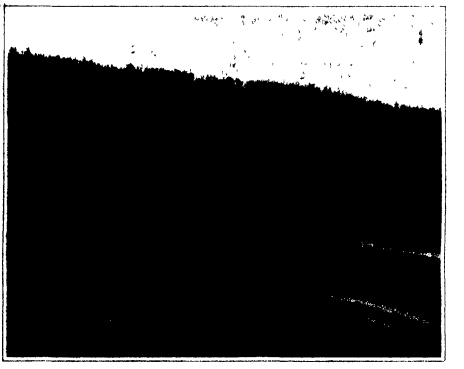
I am far from having any quarrel with the fullest exercise of State sovereignty over the forests within the boundaries of each State. But the problem of the forests, like the problem of the streams, is by its very nature an interstate affair. It may take long to work it out, but before we are through with it the regulation of the lumber industry in the interest of the public welfare must be and will be accomplished mainly by the nation itself.

There are then two principal things to be done. First, the States and the nation must improve the conditions which now surround and retard the practice of forestry by private owners. Second, the destruction of our forests by the private owners of timber lands must be stopped. I anticipate with confidence that the lumbermen will give their powerful help in the task, but whether they do or not, the problem is far larger than anything except the nation itself, and the general welfare must control.



Trails and telephone lines are essential to protection of forests from fire.

AIDS TO FIRE PATROL



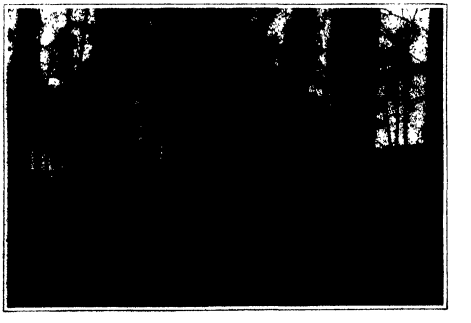
The denuded lands are privately owned, and have been logged under ordinary methods. The upper slope is on a national forest, and has been logged conservatively.

NATIONAL AND PRIVATE OWNERSHIP



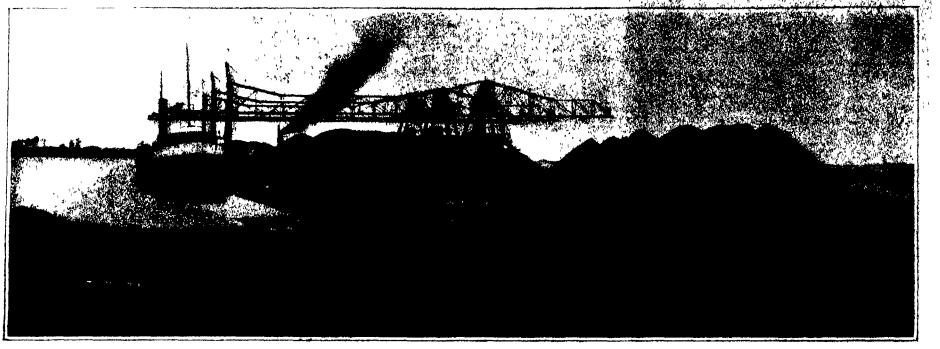
Young growth coming in on old burn was in a national forest and protected from fire.

THE RETURN OF THE FOREST



This forest has been cut without injury to young trees, left standing, which will produce good second crop.

A FACTORY OF WOOD



Unloading coal at a lake port.

The Use and the Waste of Our Coal Supply

At the Present Rate Coal may be Exhausted while the Nation is Yet Young

By Dr. Joseph A. Holmes, Director of the Bureau of Mines

THE habit of waste is one of the unfortunate inheritances of the 20th century American citizen. It is our most serious hinderance to the development of both individual and national efficiency. More than anything else, it stands in the way of the wise use or conservation of the resources, ample, present and future, supplies of which are essential to our individual and national welfare.

This fact is important enough to command attention when applied to products of the soil of which we have new supplies each year, or to our forests of which each century may bring returns, or to the soils themselves to which the underlying rocks slowly yield new additions as by careless culture we permit the fertile surface to be eroded and carried off to the sea. It is still more important when applied to our mineral resources, of which we have but the one supply—which supply has required millions of years for its accumulation, and which supply at the present increasing rate of consumption may be exhausted while the nation is yet young, and especially when applied to our fuel resources of which the portions used each day are completely destroyed.

And, yet, the very abundance, and supposed abundance, of our mineral resources has developed and encouraged the habit of waste. A legislator of many years' experience in national affairs, was recently quoted as saying in a public address: "Why, worry ourselves about a future coal supply when there is undiscovered coal enough in the Rocky Mountain regions to warm this nation for an indefinite future." Another of our "older statesmen" has in recent public utterance voiced the same view: "We have enough coal and to spare," he said, "for a thousand decades of our national history; therefore, we need not concern ourselves about the age, nor the waste of American fuel." And the average citizen has so long heard so much about the "exhaustless resources" of this country, that he is half way inclined to believe such statements.

It is only within the past few years that the real facts of the situation have impressed themselves upon us. The end of the coal supply in certain important centers is found to be already nearly in sight. The cold-blooded statistician studying the future in the light of the past, tells us that, if the increasing rate of consumption of the past century be continued in the future, our national coal supply may be exhausted within less than two hundred years. The States that first feel the effect of this fuel exhaustion, in spite of their larger supplies, will be those like Pennsylvania, West Virginia, Ohio, Illinois, and Iowa, located near great manufacturing and transportation centers, and upon whose supplies the largest drains are being made—both in the use and the waste of essential resources.

Be this all as it may, as to one fact and principle all thoughtful citizens must agree, namely, that while no one questions the right of each generation to use efficiently of this coal supply all it really needs, this right carries with it a sacred obligation—that no man and no generation of men shall waste that which is not needed for its actual use, and which, therefore, belongs to the nation.

Waste in Mining Coal.

The fact that the loss of coal in mining operations now approximates 250,000,000 tons per annum; or that we leave underground in such condition as to make its future recovery impracticable, half a ton for every



Removing coal from hold of lake steamer to a storage platform.

...mined coal, prior to its reaching the surface, is a fact that ...mands careful consideration. And what makes ...s still more serious is the fact that this coal left ...derground is often a menace to property by origin...ting or harboring mine fires, and often a menace to life by developing surplus of explosive mine gases that may by falls or settling of roof be driven unexpectedly into the working parts of the mine, where open lights or other agencies may ignite it and cause a mine disaster.

In some mines from sixty to ninety per cent of the coal is brought to the surface. In many mines the recovery ranges from sixty to seventy-five per cent of the whole, while in some mines the recovery is from forty to sixty per cent. In some cases this loss consists mainly of the pillar coal left in place to support the roof while the other coal is being removed, and which pillar coal may be later not removed or only partially removed

In addition to this pillar coal in many mines there is a "roof coal or "rooster coal," or "top coal and also a "bottom coal, which is also left underground because lower in quality or more expensive to mine

Additional losses of coal coming from the pulverizing action of the drills and coal cutting machines (see photo) from the grinding of coal under the wheels of the mine cars (see photo), and from the sorting or screening and washing and general handling about the shaft and tipple Much of the fine coal in the mines is not removed and remains as a menace to life if involved in dust explosions Much of the fine coal removed from the mines accumulates in the great black piles of *culm* where it may or may not burn from spontaneous fires, or it may be shipped away and marketed as slack or in a few cases this fine coal is being briquetted and sold at prices as high as those obtained for the best lump coal

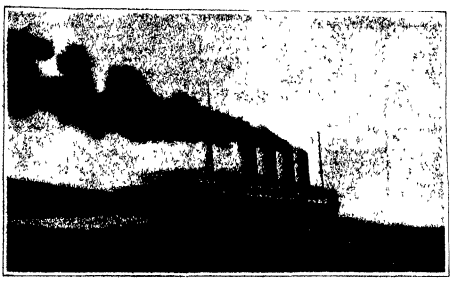
All the above sources of waste relate to the losses in mining a single bed of coal Still other losses come where several beds of coal occur one above the other with thin intervening beds of rock from the prior mining of the lower bed This often results in an irregular breaking and settling of the overlying bed or beds of coal in such a manner as to seriously interfere with the subsequent mining and recovery of this overlying or upper coal

In other countries regulations require in such cases the prior mining of the overlying or upper beds of coal in order to avoid this unnecessary settling and breakage of successive higher beds But in the United States each company has followed the law of "present profits and least resistance and the 'future welfare of the nation has remained an irridescent dream

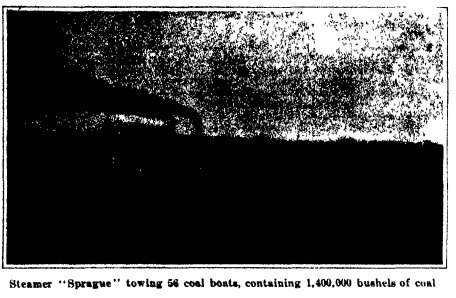
Losses in the Transportation of Coal.

From the shaft and the tipple the coal falls into the forty or fifty ton coal cars for transportation by rail (see photo) or into the barges for transportation by river (see photo) In these transport barges, as seen on the Ohio and Mississippi rivers, a single small stern-wheel steamer attached at the rear of the group of the barges, may carry to New Orleans from 40,000 to 60,000 tons of coal (photo)

If intended for ocean or lake transportation by steamer, the coal may be allowed to run from the opening in the bottom of the car (or an elevated track) directly into the hold of the steamer; or each car may be elevated separately and inverted, the coal rushing down the chute into the steamer's hold. At the other terminal port the coal whether transported by barge or steamer is lifted by great steel grab buckets and placed on storage platforms (see photo), or again placed on cars for further transport (see photo) At every handling of the coal there is an increase of fine coal or slack (photo), and a small per cent of loss But often the total actual waste in the haulage, including the several transfers, will aggregate less than 10 to 15 per cent of the original tonnage, and while the fine or slack coal sells at prices from 20 to 50 per cent lower than the good lump coal, with modern automatic stokers and briquetting plants, there is really little loss in actual heating value



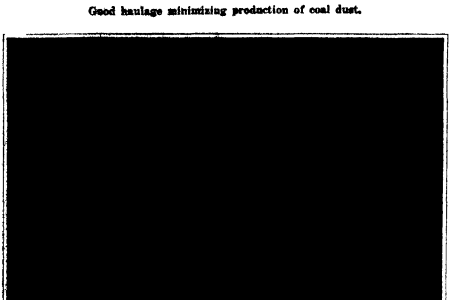
This ship consumes 1050 tons of coal each day



Steamer "Sprague" towing 56 coal boats, containing 1,400,000 bushels of coal



Good haulage minimizing production of coal dust.



Undercutting coal with compressed air drill.

THE USE AND WASTE OF OUR COAL SUPPLY

Losses in the Use of Coal

Great as are the losses of coal in mining they are proportionately less than in its burning in the furnace of the country The experienced manufacturer who as a large consumer of coal habitually watches the double entries on the pages of his ledger for profits and losses does not hesitate to express his surprise and disapproval when he hears the story of mining losses approximately 250 000 000 tons of coal in a single year but in doing this he often loses sight of the no less serious fact—that of the coal used in his own furnaces *less than 10 per cent of its heat units are converted into mechanical work* in his factories or the larger fact that of the 400 000 000 tons of coal probably used in the power plants of the country (including locomotives) 270 000 000 * or 90 per cent of the whole was lost in the several transformations of energy and not more than 10 per cent of the heat units or the equivalent of only 30 000 000 tons of this coal was transformed into the mechanical work of the nation

The situation seems clearer if these losses are subdivided or classified This cannot be done accurately in a general statement because of the variations in the different furnaces boilers and engines But taking a common type of smaller power plant the disposition or consumption of British thermal units in the burning of the ordinary bituminous coal containing 13 500 B T U has been given as follows

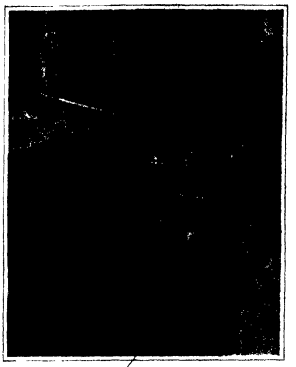
	B T U	Per cent
Loss in ashes	135	1 00
Carried off in gases	2 970	22 00
Loss in radiation from boilers	675	5 00
Carried off in auxiliary exhaust	190	1 41
Loss in radiation and leakage main pipes	210	1 56
Loss in radiation from small pipes	30	0 22
Loss in radiation from engine	280	07
Rejected to condenser	7707	57 11
Converted to power or mechanical work	1 277	9 43
	13 500	100 00

The government of the United States is probably the world's largest owner of coal lands it also operates a large number and variety of heating and power plants located in widely separated parts of the country besides the Panama railroad lines of transport steamers and its naval vessels Furthermore the fuel problem enters so largely into the manufacturing transportation and interstate commerce of the whole country that they may be reasonably classed as national problems

In recognition of these facts Congress several years ago authorized an investigation of fuel problems first under the Geological Survey and subsequently under the Bureau of Mines Under the latter bureau this work is now being reorganized and cooperating with other existing agencies the engineers and chemists of the Bureau of Mines working at its Pittsburg laboratories are endeavoring to locate and reduce or eliminate as far as may be possible the sources of loss or waste not only in the mining but also in the use of our fuel resources

(continued on page 141)

* this does not include loss which is extremely variable per cent of the coal which is distilled in making coke and passes through the gas fires in an unburned condition along with the ashes

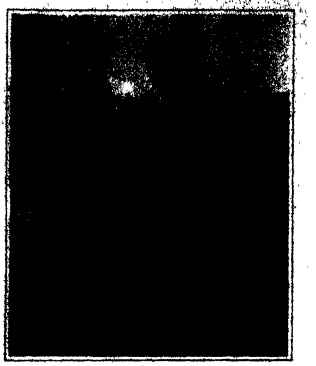


A truck with a stone-dumping body.

The Versatile Motor Truck

Novel Designs and what They Accomplish in the Economical Handling of Material

By Harry W. Perry



A truck used as a hoist.

BECAUSE the motor truck is a work machine, it is relatively ponderous and slow, but what it lacks in speed and grace of design is more than made up in the spectacular nature of its varied activities. It does not make such a direct personal appeal as the pleasure car, since not many look upon the business vehicle now as a machine from which any personal pleasure or direct benefit can be derived. When, however, the mind dissociates from the mention of commercial motor vehicles the thought of mere substitutes for horse-drawn trucks and delivery wagons, it will become evident that the term embraces a great variety of types—all, in fact, that are not classed as private pleasure cars. While motor trucks are business vehicles, they are not necessarily prosaic.

In due time more interest will be shown in so-called commercial motor vehicles than in private pleasure cars. The masses in the cities will come to realize that they have as direct a concern in motor omnibuses, taxicabs, sightseeing cars and the varied types of municipal vehicles and cars for Federal purposes as they have in runabouts, touring cars and limousines. In the self-propelled fire apparatus with which all progressive cities will be supplied in a few years, the people will see the instruments of thrilling rescues of human lives and property. In motor patrol wagons they will see the means for prompt quelling of riots and removal of dangerous and disorderly persons; in motor ambulances the vehicle for relieving human, equine and canine suffering, in the motor mail wagon the mechanism for hastening communication.

When we consider the conditions that will prevail when these types of power vehicles and the great variety of other forms for industrial and mercantile purposes have been generally adopted, and when we shall have an opportunity of comparing the clean, smoothly-paved streets, the freedom from flies and germ-carrying dust, absence of the noise of pounding horse hoofs and steel tires, reduction of traffic congestion and the elimination of the harrowing sight of horses prostrated by midsummer heat or crippled by winter's ice pavements with conditions that prevail now, every thinking person will be impressed with the idea that the pleasure car with which the civilized world has been obsessed for more than half a decade is, after all, a relatively small factor in a revolutionary change in a method of transportation almost as ancient as the human race, and that this change touches the life and has a direct bearing upon the well-being of every individual in the city.

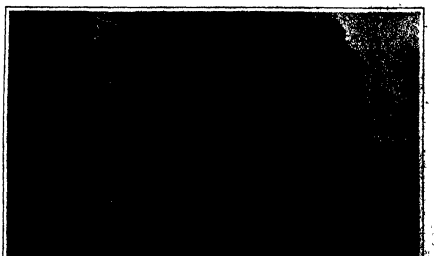
Aside from the striking nature of public services in which motor vehicles are engaged, there are many applications of the machines to private enterprise that are most interesting. All sorts of work, from thawing frozen water pipes in an emergency, to drawing plows in the farm fields, come within their scope of utility. At least 125 distinct lines of trade are using the trucks built by a single big manufacturing company that produces only machines of three tons capacity. It is natural, of course, that the motor truck should have been adopted more generally by the lines of business that found the horse least capable of doing the work required, either because of its difficult nature or because of long distances to be covered in a short time and long hours of service that would seriously fatigue the best animals.



A tilting body operated by means of a hand winch and rollers. This operation does not require any greater physical exertion than the cranking of an ordinary gasoline motor.



A motor truck carrying not only its own load but hauling an ordinary truck as well.



A truck unloading boards. The driver sits in a cab which completely protects him from wind and weather.

Just to cite one kind of work that is beyond the capability of horses to do successfully, it will be remembered perhaps that early last spring several sixty-ton steel girders for the new Municipal Building in New York were hauled from the river front, near the Battery, to the location of the building at the Manhattan end of Brooklyn Bridge. Thirty-six horses, hitched in an almost unmanageable string of eighteen teams, were used for draft purposes, and because of the interruption of traffic and confusion that would have been caused in the metropolitan streets of such an outfit during business hours, the girders were hauled during the night and on Sunday. In their passage numerous iron manhole covers were crushed in and considerable damage was done to the street paving. It is not difficult to imagine the vociferous bedlam that accompanied the movement of the teams and the noise made by one hundred and forty-four iron-shod hoofs, and the almost insurmountable difficulty of making the long string of horses pull in unison, and of turning corners successfully. A five-ton electric truck used for the same purpose in another city moved with ease a trailer weighing five tons and loaded with a steel girder which alone weighed twenty-six tons.

One of the most exacting branches of transportation work is that of the big express companies, which receive and send their shipments by fast passenger train and must perforce conform to railroad schedules. All of these companies use some motor wagons, and one in particular, which has used steam, gasoline and electric power wagons continuously for the last eighteen or twenty years, now does the major part of its transfer and delivery work with electric wagons in the principal Eastern cities. The gasoline trucks owned by another of the national express companies are operated on a time schedule as exact as the railroad time sheet, and are kept in service twenty hours out of twenty-four, with a double shift of drivers.

Delivery work for department and dry goods stores calls for the covering of routes too long to be successfully served by horses. One New York store has a route of more than sixty miles that is covered daily by one motor wagon and one driver, with an average of about one hundred stops for delivery of parcels. Horses, of course, could not be used in this case, for even if two changes of teams were made in the day, the speed could not be maintained. Some big department stores make their long hauls into outlying residential sections at night, and make their local deliveries the next day from distributing depots. In this way one big house keeps its heavy trucks running twenty-two hours a day, except on Sundays, when they are given a thorough inspection, cleaning and adjusting. A trip on one of these department store or express trucks in the middle of the night would prove quite as novel and interesting as a night run of the same duration in a touring car under ordinary circumstances.

Coal, beer, lumber and machinery trades and many lines of heavy manufacturing whose hauling is hard on horseflesh have adopted the motor truck freely and are getting excellent service from the machine. Peculiar conditions that obtain in some of these businesses have resulted in the development of special quick loading and unloading methods whereby the vehicle can be kept on the move during the maximum number of hours daily, thereby realizing the principal advantage that it possesses in superior speed and endurance over horses. Coal dealers order their power trucks fitted with bodies which are provided with chutes, and which can be raised above the frame of the chassis at a sharp angle so that they will empty their loads of from three to ten tons by gravity in from five to fifteen minutes, with little or no shoveling. Contractors are becoming frequent purchasers of motor trucks fitted with dumping bodies that can be discharged of their loads sometimes in less than a minute. Most of the dump trucks so far built are tipped by the manual turning of a crank, but several have been built to order that are equipped with power-operated tipping mechanism. One of these is a seven-ton gasoline truck that is often used for hauling hot asphalt. This material has a tendency to stick, and consequently the body had to be constructed to tip to an angle of forty-five degrees. It takes only forty seconds to elevate this body with power from the engine and discharge the seven-ton load.

Ingenious quick loading and unloading methods have been developed by the lumber trade whereby a motor truck can take on a load of three to seven tons of lumber as a unit in a few minutes, the turning of windlasses by hand serving to roll or slide the load from a horse truck upon the power vehicle, which then leaves the yards to deliver it. The horse trucks are driven to the different lumber piles to be hand loaded, and thence to the wagon shed to await the motor truck, a single team of horses sufficing for about a score of such wagons. The loads can be discharged from the power trucks by releasing ropes or chains at the rear end and allowing the lumber to roll back by gravity or by rolling the load back by turning the cranks on the rear end rollers until the ends of the boards drop to the ground. Then the truck is driven out from under the forward end of the load.

A leading department store in New York and another in Pittsburg operate eight or more three-ton trucks each that are especially arranged for quick loading and unloading. Light bodies of crate construction are built to fit inside the regular covered bodies. When a truck arrives at the store this inner body is withdrawn upon a hand truck to the rear, and on this is taken to any floor in the store by means of a freight elevator to be loaded. A duplicate crate that is waiting ready loaded to put its predecessor in place is then run out on the hand truck, and the truck starts off with it. The reverse process occurs at the other end of the truck's route. In a record load for one of these trucks at Christmas time were 3,000 parcels. Ordinarily the proper loading of the packages requires from one to three hours, so that the system enables the truck to make two or three times as much mileage as would be possible if it had to stand idle while undergoing the ordinary loading and unloading processes. The average daily mileage of seven of these trucks used during a fifteen-month period in New York was seventy-two miles each, counting twenty-six working days to the month. Several of the machines averaged one hundred and ten miles a day for months at a time.

The combination of vehicle and power plant that constitutes the motor truck renders the machine available for many classes of work heretofore done by hand and by portable or stationary engines. In fact, it is a self-moving portable power plant. In its most common form as such it is fitted with a winch or windlass, usually under or just back of the seat, which is turned by power from the vehicle. The winch may be gear driven from the engine of a gasoline machine, or turned by a small independent electric motor supplied with current from the battery of an electric truck. In either case the winch can be used for a variety of purposes. Both types of trucks are used by a large safe manufacturing company which utilizes the power winches for loading the safes on the platform of the truck by drawing them up a pair of skids and also for hoisting the safes to and lowering them from windows of any floor in tall office buildings. This method has the advantages of being quick, safe and cheaper than the old way of having a gang of workmen turn a hand windlass. Fewer men are needed, passersby on the walk and traffic in the street are inconvenienced for a shorter time, and customers of the company are better satisfied by the briefer interruption of their office work.

A few years ago all telephone, telegraph and electric light and power wires that were placed in underground conduits were drawn into place by gangs of laborers who turned huge wooden capstans that had to be set up in the street anchored in position by iron pegs driven in the pavement and moved from block to block on wooden rollers which were taken from behind and put in front as the capstan moved along for the next successive step in the work. Compare this primitive procedure with the present-day way, in which cables of wires are drawn into place under the street by power winches on heavy five-ton motor trucks. In New York one electric light and power company uses half a dozen such trucks for this purpose, and also for the more spectacular work of erecting the heavy ornamental cast iron electric light poles used for city lighting. These poles are thirty feet long, and are much too heavy to be set up by laborers without a derrick. But the truck, with its power winch, makes easy work of the task.

By way of an aside, it is pertinent to observe right here as an indication of the trend toward the horseless condition that is predicted for large cities in the near future, that the New York Edison Company has abandoned altogether the use of horses in Manhattan and a large part of the Bronx, and employs instead a "fleet" of eighty electric trucks and delivery wagons. Within the next five years, and probably sooner, it will get rid of all its remaining animals, as will also the New York City Fire Department, some of the express companies and many retail houses in the metropolis, some of which are now operating from forty to nearly one hundred motor delivery wagons.

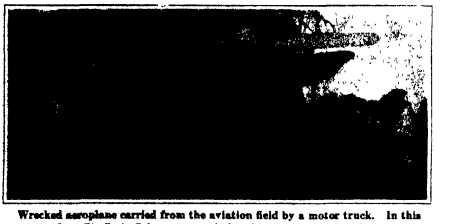
In addition to the ways already mentioned, the power plants of motor trucks are used in an auxiliary way for pumping water out of manholes in the streets of cities.



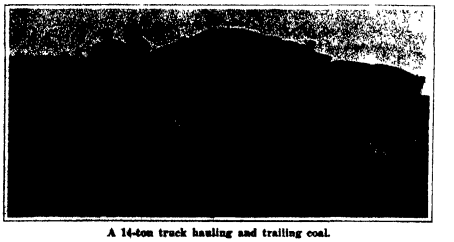
An ambulance in action.



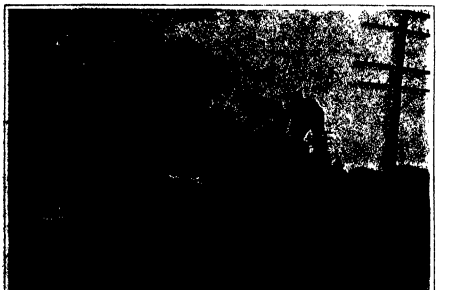
A motor truck carrying Ovington's 70-horse-power Bleriot machine to an aviation meeting.



Wrecked aeroplane carried from the aviation field by a motor truck. In this aeroplane St. Croix Johnstone nearly lost his life at Detroit. The truck arrived at the scene of disaster almost as soon as the ambulance.



A 14-ton truck hauling and trailing coal.



A 3-ton truck moving camp equipage in maneuvers of the 30th infantry, U. S. A., south of Detroit, June 1st, 1911.



Typical group of California oil wells. Note lake of oil in foreground.

Conservation of Oil and Natural Gas

Economies in Field, Factory and Home

By Dr David T Day, United States Geological Survey

IN regard to conservation of our natural mineral resources the petroleum industry affords a better example of what can be accomplished in useful application and preventing of waste rather than an illustration of deplorable waste which has been the theme of most that has been written on this subject for other industries

Nevertheless the petroleum industry is one of the most vital cases for exercising every possible care in the utilization of a limited amount of material The gloomy outlook for the United States without great care in utilizing the stores of petroleum and other fuels is well illustrated by the present condition of Italy For in spite of a climate unrivalled for the growth of plants and with men and women strong and skillful in the arts of agriculture the peasants are proverbially poor Only a few days ago in looking at an Italian photograph of an unusually strong woman carrying on her head a large bundle of firewood I was puzzled to explain how poverty was consistent with this magnificent physical development and yet the picture carried in it the obvious reason The world has moved past the stage when human power is sufficient in daily labor Aid must be had from power from a large supply of cheap fuel in addition to the energy to be contributed by human labor and only the countries prosper where such fuel is abundant Italy's fuel supply has burned out unless they harness the exhalation from Mt Vesuvius Even the wood which the woman in the picture was carrying is scarce and costly and in no way sufficient for the development of enough energy for efficient manufacture

Contrast this condition with the United States We have a supply of at least 10 billion barrels of petroleum in what we already know of the resources of the United States From these vast resources we produced last year over 200 000 000 barrels of oil In addition we produced natural gas to a value of at least $1 000 000 In other words leaving out of consideration copper and iron the oil and gas of the United States was worth more than the gold silver, lead and every other metal product produced in the same length of time It is important to emphasize the fact that we do not need this great production But there is no possible method of preventing the producers of oil from taking it from the earth as rapidly as possible when they either own the oil lands or own leases on the oil lands and there is no way of curbing the haste with which the oil is pumped out by one producer lest his neighbor will secure the greater part by prompter action The ability of the owners of any large tract of oil land such as the people as owners of the oil on the public domain or of any large oil company with a large tract of developed oil land to withhold development on these large tracts is admitted but aside from this the human oil fields will be developed as rapidly as human enterprise can put the product above ground

Intelligent utilization of oil therefore has had to face extreme conditions of sudden floods of oil and in general more oil than was needed These exceptionally trying conditions have been met with a significant success It is very much easier to record the failures to conserve rather than the nearly uniform success When the Lucas gusher broke loose near Beaumont Texas the oil was lost for lack of tankage for a few days and fire added to the waste In the opening days of the Glenn pool in Oklahoma oil ran to waste down the creek and in California the first flows of the Silver Tip the Lakeview and other gushers have been lost but the total loss from all these sources is trifling

This is an achievement which calls for great congratulation rather than the criticism of methods which has been found necessary in considering the conservation of coal and the shameful devastation of our forests Perhaps it will be useful to discuss how this careful saving of petroleum has been brought about as a means of inspiring similar enterprise in other industries

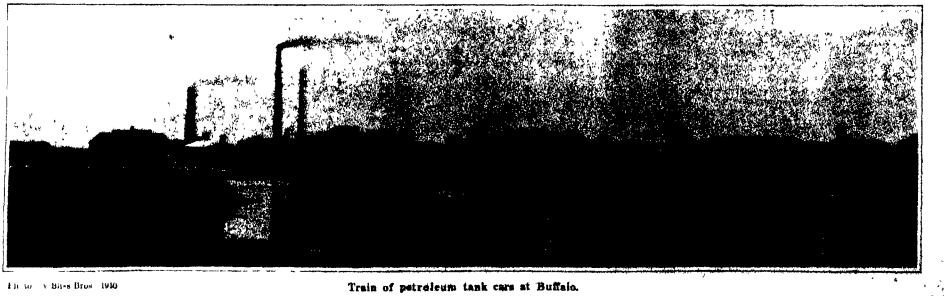
Oil conservation goes back beyond all the oil companies great and small and begins with Samuel Kier a merchant of Pittsburg who was also from necessity, an inventor or better still an adapter, of a lamp for burning oil He added a chimney which made the oil burn with a bright light This supplied a market which did not before exist and which has spread from Pittsburg to remotest China A C Ferris came next with his genius for oil traffic He began the process of exporting oil from Pittsburg to the ends of the earth From that day to this business sagacity has dominated oil

Pipe Lines—It was the spur of business competition that developed the *pipe line* at first facing hostility and actual violence from the army of teamsters in order to get the oil from the well mouth to a railroad or river landing and finally invoking engineering skill the *oil* men emancipated *themselves* from railroads and pumped oil over the Alleghenies to tide water Pipe line efficiency has been perfected in both directions—toward the consumer and toward the producer The refineries have tended to accumulate near the coast because it was evidently cheaper to transport the oil in the crude condition as far toward the consumer as possible and only to resort to costlier transportation methods when it became necessary to convert the oil into the products to be consumed each of which must be distributed by its own system

The pipe lines have increased in number and economy has been promoted by the best types of pumping equipment In fact pumping engines have been greatly developed for all purposes by the demand for them afforded in transporting oil

Meantime the branch or 'gathering' lines have crept outward as the oil pools increased until there are now many miles of pipe lines in the United States Of greatest help however has been the system by which the pipe line has always been extended to the well mouth *promptly* when new fields have been discovered The only burden for the oil producer has been the development of his oil pool It has become axiomatic that the oil is as good as sold as soon as it is produced

Uses of Crude Oil—It is evident that the requirements of the moment must be considered in the uses



Underwood & Bliss Bros 1916

Train of petroleum tank cars at Buffalo.

for oil, and not the ideal utilization based upon the highest grade products that the oil can be made to yield. In fact the sudden floods of crude oil have made it necessary to get rid of the oil for any purpose whatever, so long as the oil is consumed. Of the entire supply, the greater part has been distilled and refined so as to yield the greatest amount of lamp oil of satisfactory quality and the minimum of by-products such as gasoline, paraffine wax, lubricating oil, and coke products. Usually there has been a steady market for lamp oils at home and abroad. Within the past few years this policy has of course greatly changed, due to the increased demand for gasoline, and due also to the over supply of kerosene. The consumption of kerosene has not declined. It has increased, but not so rapidly as the production of crude oil.

Fuel Oils.—This necessity of forcing a market for crude oil has developed uses which might long have lain dormant. Chief among these is fuel oil, second, and always increasing, is road oil. Luckily the recent great finds in Texas and California have been very suitable for use as fuel for power purposes. Under extreme conditions, all kinds of crudes have been used for fuel, but they are better suited for the purpose when the gasoline and burning oil have been removed. Fortunately it pays to take out these portions, and therefore the so-called "skimming" plants have been successful. As a rule wherever these fuel oils have been used an advantage has been demonstrated. This includes all kinds of power plants, locomotives, and finally the marine engine. The advantage on locomotives is evident, for the size of a locomotive is limited by the amount of coal that a fireman can feed in a given time. Thus in the Northern Rocky Mountains the limit of size has been reached by this human limitation, at least until an oil supply can replace the coal. Then the size and efficiency may increase again.

Internal Combustion Engines.—For marine power, oil's efficiency includes, besides increased capacity, elimination of the smoke nuisance on passenger craft, with its attendant cost of paint, and of the smoke danger for war vessels.

Oil in the Navy.—The effect of this is that more than 25,000,000 barrels of oil per year must be set aside for naval purposes in the United States, and the merchant marine will require as much more. Further it must be remembered that the great majority of the known petroleum resources of the world are here in the United States. One effect of this was seen in the days of the flood of oil at Beaumont, Texas, with oil selling as low as 10 cents per barrel, where it was recklessly applied to any purpose. Every effort was made by those interested in the welfare of oil to induce the changing of the use of petroleum into other more conservative uses, such as distilling out as much gasoline and kerosene as the oil will yield, and converting as much as possible of the residuum into various lubricating oils and thus avoiding the use of oil as a low grade fuel in competition with coal. Now, however, for the reasons given, the use of oil in internal combustion engines has become one of its most beneficial uses.

In the future, therefore, we can expect the very best utilization of our valuable oil supplies to proceed along the lines of burning it for the production of power. This method of burning oil constitutes an example of modern conservation of resources.

Oil for Good Roads.—Another use that can really be considered as consistent with the conservation of our mineral supplies is the use of petroleum residues for making good roads. Road oil, as manufactured from Texas and mid-continent oil residues, probably produces as great economy in national life as any other use to which it can be put.

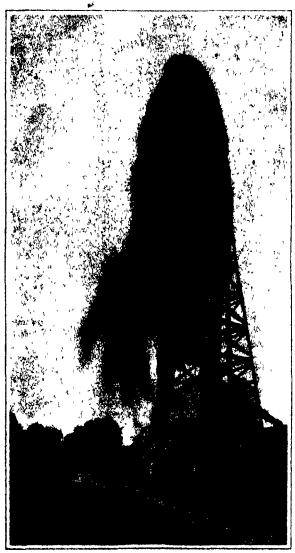
Lubricating Oils.—Meantime we must not lose sight of the fact that modern progress would cease, the movement of all machinery would stop, were it not for mineral lubricating oils. The former supplies of animal and vegetable oils suitable for lubrication are trivial compared with the demands of modern machinery. Mineral lubricating oils are as essential to machinery as the telephone is to the conduct of business affairs.

Protection of Future Supply.—As already pointed out, we are producing more petroleum than we need, and we are obliged to export the surplus. This surplus goes to the ends of the earth, and from the broad standpoint of the world's economy it is necessary for progress. From the more limited standpoint of the economy of the United States, it would be better to keep it at home until needed.

The necessity for thus husbanding our petroleum resources is so evident that it will be accomplished, partly by the purchase of large tracts of petroleum lands by large corporations who will hold these supplies for the future, and partly by the withdrawal by the National Government of such oil lands as remain on the national domain in the interest of future use. A most favorable sign of the times is the agreement between companies in California that each shall keep back a certain number of hundred feet from the dividing line in order that neither party will draw the oil from the other's territory—an arrangement which makes it no longer an inducement to withdraw the oil from one tract to prevent its being exhausted by the wells of a rival tract. The extension of this policy is consistent with common sense and business interests. Two recent very successful feats in oil engineering have greatly improved the prospects of a long continued natural gas supply in the United States. A great source of loss in this country has been the waste of at least 100,000,000 cubic feet of natural gas per day in the Caddo field in northwestern Louisiana. Repeated claims have been made that these oil and gas wells could not possibly be controlled. Within the last two months the engineer of the Caddo Gas and Oil Company, of Shreveport, Louisiana, has completely controlled one of these great volcanoes of gas, water and oil, and the feat was so easily accomplished as to make it altogether probable that the other wells will be quickly controlled in the same way.

At the time this article is being written, another great problem is being solved in this same Caddo field. An oil well gushing at least 20,000 barrels per day, together with a large quantity of natural gas, has been on fire for several weeks, defying all attempts at extinguishing the fire or controlling the flow. As a last resort a tunnel has just been finished. The intention is to cut the pipe and divert the stream of oil through the tunnel and thus extinguish the fire and control the well.

With the steps thus in progress for the conservation of oil resources, it is probable that the oil supply of the United States is in a fair way to be protected for many generations to come, and it is certain that the methods of using this material are more satisfactory than for most other minerals.



Typical oil gusher.



Toure petroleum peddler. Roumania.



Petroleum peddler. Roumania.

OIL IN EUROPE

Injury to Lumber by Fungi

BLUE and black stains on lumber stored in yards decrease the value of the lumber, without, however, injuring the wood, since it has been found that the fungi which cause the stains feed upon the materials within the cells of the sap wood, and do not destroy the fibers. These fungi are largely of the black knot family, and the most common are species of *Graphium* and *Ceratostomella*. It has been the custom of the lumber companies to dip the wood in solutions of sodium carbonate or bicarbonate immediately after the sawing, but the results have been very uneven. To find out why the alkaline solutions sometimes prevented the development of the fungi, and at other times had no effect whatever, Miss Caroline Rumbold started a series of experimental cultures at the Missouri Botanical Garden in St. Louis.

Nutrient media were prepared containing from one-half to two per cent sodium carbonate, and others with similar amounts of citric acid. The spores of *Ceratostomella* germinated and the fungus thrived on the acid media, and on those containing 0.5 per cent of Na_2CO_3 but not on those with 1 per cent or more of the alkali. Freshly cut sap boards of yellow pine and red gum were then dipped in hot and in cold solutions of sodium carbonate and of sodium bicarbonate, of various strengths from 1 per cent to 10 per cent. These boards were inoculated with the spores of the fungus and kept in chambers with a saturated atmosphere. Controls were simply dipped in water, and some of the red gum boards also in sulphuric acid (5 per cent and 10 per cent). The fungus developed on all the controls, including the sulphuric acid boards, and on most of the boards dipped in the alkaline solutions. The hot dip was found to be more effective in inhibiting the growth than the cold solution, and the carbonate of 7 to 8 per cent as effective as bicarbonate solution of 8 to 10 per cent.

Increase of Crop Yield in Germany

ON the twenty-fifth anniversary of the German Agricultural Society there was published a table showing the progress in the yield of various farm crops during the quarter century. Some of the items are given below, the figures representing pounds per acre.*

	1885	1910
Rye	1,050	1,486
Wheat	1,344	1,771
Barley	1,315	1,745
Potatoes	8,989	12,470
Oats	1,255	1,719
Hay	2,910	3,863

It is pointed out that this progress is not due merely to better treatment of the soil or to more abundant fertilization, or a more intelligent selection of seed, etc., as is commonly supposed, but also in a measure to a differentiation of crops in accordance with the adaptability of each particular type of soil.

*Original report, quintals per hektare.

Reclamation and Home-making

I.—Review of General Conditions in the Reclamation Service

By F. H. Newell, C E., Director

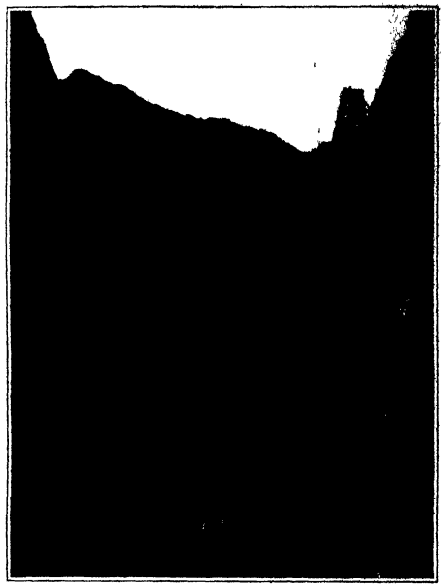
ONE of the most far reaching but little known works of the United S[illegible] is that of the reclamation by irrigation of arid lands. These lands form about one third of the total area of the United States and although only a small proportion can be irrigated yet the farms and homes which may be created have such great value as to become a notable addition to the wealth of the nation

It is not however the object merely to reclaim these lands and to add them to the productive capacity of the nation Far beyond this is the higher object to be attained that of rendering these areas capable of furnishing homes for thousands of citizens The lands are not irrigated that they may add to the wealth of a few but when reclaimed they are subdivided in tracts each sufficient for the support of a family and are disposed of to persons who will live upon the land for five years cultivate it and become self-supporting citizens and taxpayers

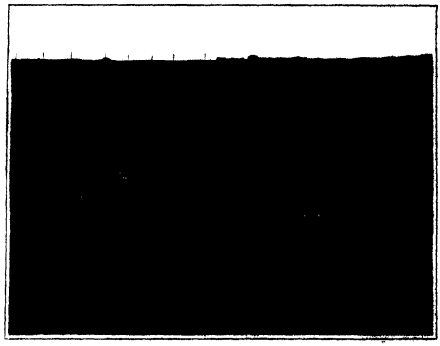
The public lands thus reclaimed are not sold but are given away to actual homesteaders The cost of the reclamation however must be returned in ten annual instalments Thus for example if it has cost $30 an acre to bring the water to a given tract and it is found that 40 acres is adequate for the support of a family an individual is allowed to file upon this 40-acre tract title is obtained after five years residence and cultivation and payment to the government of the cost of reclamation which in this case is $1 200 in annual payments of $120 each He obtains an opportunity of acquiring a home and a piece of land which rapidly increases in value because of the fact that as other people flock in and take up the adjacent lands a relatively dense population is established towns grow up and there is an increment of value beyond the result of his own efforts—for these lands ultimately are worth $100 or more per acre

There has already been invested about $60 000 000 in this work and this investment is being increased at the rate of approximately $1 000 000 a month This money is not being paid directly by the tax payers as it is not derived from domestic or foreign imports but from the disposal of public lands The moneys thus obtained are credited to a fund in the treasury placed at the disposal of the Secretary of the Interior and expended through what is known as the Reclamation Service an organization composed of engineers with necessary technical and clerical assistants

The law authorizing this work known as the Newlands Act from Senator Francis G Newlands of Nevada was passed on June 17th 1902 It is very general in character calling for certain results and laying down a few broad lines to be followed All of the intricate detail had to be worked out It was as though a great business enterprise had been authorized without indicating dimensions character of structure or any facts excepting that certain funds of unknown amounts were to be expended to accomplish results in localities widely separated The location of the works for the most part in regions remote and without adequate transportation facilities the magnitude and complex character of the engineering features and the difficulties encountered in adjusting the diverse interests of private owners furnished innumerable problems the solution of which required a vast amount of investigation and study The first thing after the passage of the act was to get the engineers The natural thing to do was to continue in the work the men who had been studying the subject for many years, and then to select a few localities and begin the work



Shoshone dam, 328 feet high. Loftiest in existence.



The desert before irrigation.



Homestead on same desert two years later.

SHOSHONE PROJECT, WYOMING

There were demands from all parts of the arid West that work should be undertaken at once, and the people were inclined to chafe at any delay in the beginning of actual construction It was difficult to make them understand the need of preliminary study and investigation they wanted to see the dirt flying and the big dams rising in the canyons.

It was known as the result of previous investigations that several projects undoubtedly were feasible, and that certain large structures must be built in connection therewith Work was, therefore, begun on some of these before all the plans could be elaborated Those matters upon which there could be little question were at once entered upon, the connected details and plans for additional structures being worked out while building progressed.

The result is that a large amount of work has been accomplished in a short time and a reputation established for prompt execution as against the idea that government officials could not move expeditiously

At the same time, every effort has been made to preserve accurate records of the cost of the work and to study all of the economies which were practicable under existing laws and regulations Cash discounts were sought, as well as wholesale rates Transportation of material was secured at the lowest obtainable terms and the operations put upon a business basis What this means can never be appreciated by a man who has not worked for the government, and who has not run against the innumerable complications growing out of a century of corrective legislation and executive requirements Transacting government business on business principles is like trying to drive directly across a settled valley which is fenced in every direction by barbed wire The old inhabitant knows the highways and byways the gates and the openings and can go across the country with considerable speed but the newcomer who does not know these is constantly getting entangled in wire fences and in controversy with the people and is forced to back out and finally go by the most roundabout road.

The Reclamation Service has been particularly fortunate in its ability to traverse rapidly and effectively the entanglements of legal obstacles discovering the openings and short cuts which expedite work

Acting under a very general law in which results only are called for, it has been possible to avoid many of the embarrassments of the more elaborate enactments of Congress, where the attempt has been made to describe in advance all sorts of remedies for every kind of emergency. Nevertheless, there are enough general laws and restrictions to necessitate the greatest skill and care in making expenditures without getting one's self into continual trouble.

One of the methods adopted by the Reclamation Service for avoiding delay and [illegible] to have the [illegible] of funds placed in the hands of a considerable number of local agents. These men are of the employees who have been [illegible]

disbursing officers in large enough so that if the accounts of one are suspended on technicalities, another man can take charge, while the first devotes his time to satisfying requirements of the Treasury officials, thus avoiding delays.

The business methods have been the subject of continued study and examination by experts and have been so perfected as to serve as a model for various contracting or other corporations, which have practically adopted the general scheme of cost-keeping, modifying the details to suit private conditions.

It is recognized, of course, that the government bureau cannot work as economically in some ways as a private corporation, because it is loaded with requirements of advertising for competition in all purchases, of elaborate preparation of all papers having to do with disbursements, with the attaching of numerous signatures, growing out of various laws, with almost innumerable restrictions imposed from time to time to meet special conditions and also others which were never anticipated when the regulations were drawn. Nevertheless, experience has shown that it is possible to prosecute business with reasonable economy and speed. As proof of this it may be stated that already nearly a million acres of lands have been furnished with water, and about 14,000 families are on these lands These beneficiaries of the law are beginning to pay back into the Treasury their *pro rata* share of the cost of the work.

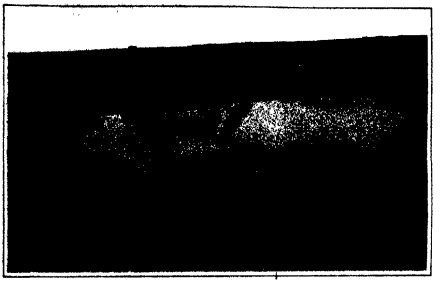
The results attained are an example of what may be accomplished in the practical carrying out of the conservation ideas, so ably presented by Theodore Roosevelt and Gifford Pinchot. In fact, the reclamation work may be considered as part of the great programme of national conservation, being joined with the protection and use of the forests, the saving of the water powers, and other natural resources and monopolies for the people. The outcome shows that it is possible for the National Government, through skill and competent officers, to grasp these great opportunities and to develop for the common good the resources, which, up to the present time, have been turned over to the great corporations, on the ground that it is impossible for the people to help themselves through a popular form of government

In carrying out the objects of the Reclamation Act, and embodying the ideas therein contained in feasible structures, there have already been built reservoirs for conserving the waste waters and having a capacity such as would cover four and one-half million acres with water one foot in depth. To distribute this water to the land, or take it from various streams, there have been constructed nearly 350 miles of canals of large size, that is to say, carrying over 800 cubic feet per second, while in smaller canals or distributaries, there are several thousand miles. The tunnels by which the water is carried under mountain masses or through obstacles aggregate in number nearly 70, with a total length of 100,000 feet There are literally thousands of smaller structures, such as gates, turnouts, flumes, and bridges, each of which has required more or less engineering skill and forethought The material excavated in building the canal system has aggregated 60 million cubic yards of earth, and nearly 5,000,000 yards each of loose rock and of solid rock In building the dams and other structures, there have been used over a million barrels of cement

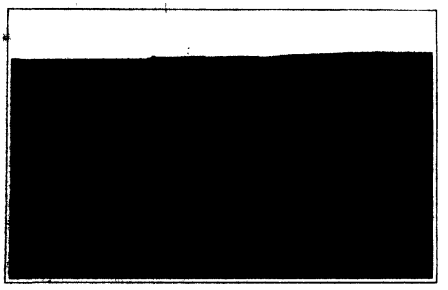
These figures will give some idea of the gross magnitude of the work; but to the men interested in scientific or engineering facts, they are less instructive than a few details concerning some of the more interesting or typical of the works now built

The results accomplished, however, are far more important than those which can be shown in figures of quantity, size, or cost They relate to those higher and larger objects of life which rank above mere material prosperity, in that they contribute to the development of a citizenship, of far greater importance to the nation than the possession of wealth The object of the Reclamation Act, while directed immediately toward the construction and maintenance of irrigation works is really more far reaching, for these works are the foundation for homes for its citizens and their use is conditional upon the ownership of the reclaimed lands in small tracts sufficient for the support of a family This means that there can be no land monopoly Each farmer or beneficiary of this law can obtain land or water sufficient only for his own use He must be one of a group of independent landowners living in relatively thickly settled communities, where success is attained through intensive cultivation, and where there thus results the ability to enjoy the comforts or even luxuries which are incident to a carefully cultivated, densely populated, or suburban locality The man who has been a mechanic or has pursued some trade in the city or has wandered about the face of the earth is offered an opportunity to secure for himself a home, with reasonable expectation of competence in his old age He must endure at first the privations of pioneering and must have energy and use good judgment, but there is no occupation in which a more substantial reward will come for efforts intelligently expended

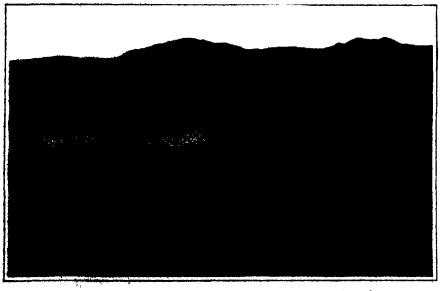
From the standpoint of the common wealth, the gain is great in transforming the indifferent citizen, who has been living in an apartment or wandering about from place to place, into a settled, taxpaying voter, interested in everything which concerns the locality, the county, the State, and the nation.



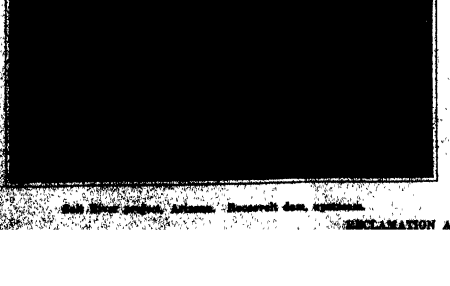
Payette-Boise project, Idaho. Flume crossing a creek.



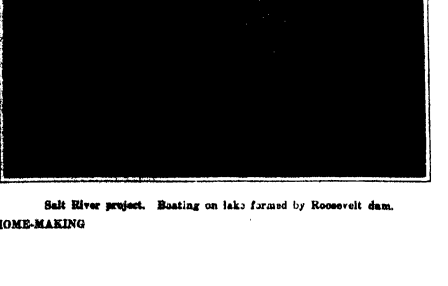
Belle Fourche project, South Dakota. Owl Creek dam.



Yuma project, Arizona. Laguna dam from California side.



Salt River project, Arizona. Roosevelt dam, upstream.



Salt River project. Boating on lake formed by Roosevelt dam.

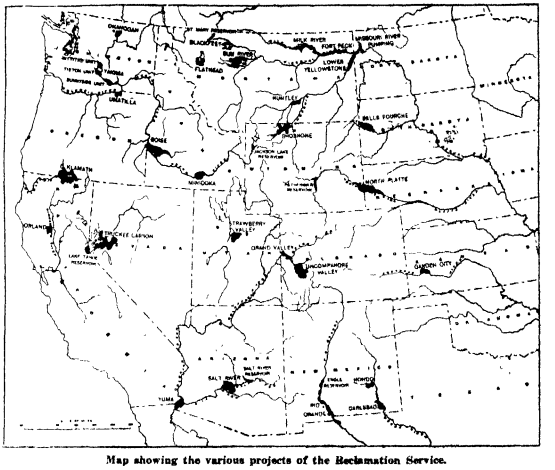
II.—The Engineering Work of the Reclamation Service

By A. P. Davis, C. E., Chief Engineer

In the early days of the operation of the Reclamation Act the principal engineering problem was the examination of irrigation projects and the selection for construction of the more feasible of these, modified by the legal requirements of geographic distribution.

The local engineers of the service made preliminary surveys which were inspected from time to time by the consulting engineers, until what was deemed the most feasible project presented by local conditions was whipped into shape and submitted to a board of experienced engineers for the purpose of determining its feasibility. A report of this board was submitted to the Secretary of the Interior, and one by one projects were approved in all of the States to which the act referred, excepting Oklahoma, in which no feasible project has yet been found. Construction began in the Carson Valley, Nevada in September, 1903, and soon after in various other States, until the approved projects were all under consideration. The construction work accomplished since the passage of the act, up to December 31st, 1910, is given in the table on page 148.

The diversion of water for irrigation in the arid regions of the United States is not new, but has been in progress for over half a century. Through the efforts of individual and corporate enterprise, the smaller and easier projects have been mostly carried out—these usually involving the diversion of the natural flow of a small stream over a smooth valley adjacent. As the smaller and cheaper projects are developed and those involving heavier work are undertaken, the development becomes more and more difficult for private capital and less certain of profitable returns. At the time of the passage of the Reclamation Act these causes had greatly checked the development of irrigation enterprises by private investment, and the engineers of the service found the projects usually involved engineering construction of considerable magnitude and difficulty. More than three-fourths of the projects undertaken require the construction of an expensive storage reservoir, and the majority also required the construction of expensive diversion dams, tunnels, aqueducts or other structures relatively difficult and expensive, and often requiring a long time in completion. For example, the Roosevelt dam in southern Arizona, recently completed, contains over 350,000 cubic yards of masonry, and forms the largest artificial reservoir now in existence, the construction of this reservoir required the expenditure of nearly $300,000 in wagon roads alone, to make the region accessible and to replace public roads submerged by the artificial lake. The heavy cost for transportation also compelled the manufacture in the vicinity of the cement, lumber, brick and sand necessary in this large construction.



Map showing the various projects of the Reclamation Service.

The storage dam on Shoshone River in Wyoming is the highest dam in the world, and the Reclamation Service is now beginning the construction of a still higher dam in Idaho.

The Gunnison Tunnel in Colorado, recently completed, is nearly six miles in length and was constructed under extreme difficulties presented by the presence of hot water and gas in great quantities, and the shattered condition of the formations pierced. The contractor for this tunnel failed and the work was carried out by the direct employment of labor under the engineers of the service; it required nearly five years in construction, and an expensive storage reservoir must yet be built to permit the complete development of the lands under the project.

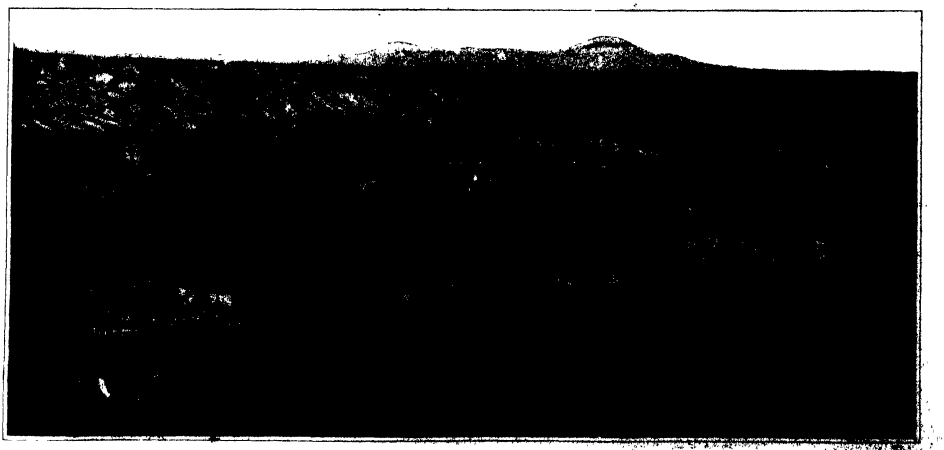
Some projects require for their proper development a very broad and comprehensive study of conditions over a large water-shed, usually extending across State lines.

A typical example of this kind is the North Platte Basin, where a storage reservoir has been completed which will store over one million acre-feet of water, and will control the entire flood of the North Platte Basin in years of ordinary flow. This reservoir will hold the water that would run to waste in the winter months, and also store the excessive flood waves from melting snow in the months of May and June for use during the late summer and autumn, when the natural flow of the river is at its minimum.

The construction of this reservoir to about the capacity above mentioned is indispensable to the complete development of the water supply of the North Platte River, its capacity is far above the needs of the government project now constructed at a cost of about $3,000,000. The surplus storage may be used in the development of additional projects in the basin, and in completing the water supply for similar private irrigation enterprises previously instituted.

The far-seeing policy which prompts the construction of this large reservoir under these circumstances would hardly be feasible for private enterprise, which must assure itself of an early return of the invested funds; yet, such policy as that followed was absolutely essential for the proper conservation of the natural resources. The same principle holds true with the majority of the larger projects undertaken.

An interesting fact, incidental to some projects,



Pathfinder dam, Wyoming; 22-horse freighter hauling cement 45 miles to dam site.

NORTH PLATTE PROJECT, NEBRASKA-WYOMING

...ation of the water power made available ... irrigation works for the increase of the water ... pumping from underground sources, and ... utilizing the existing supply by rais... of it to higher levels which cannot be ... gravity ditches.

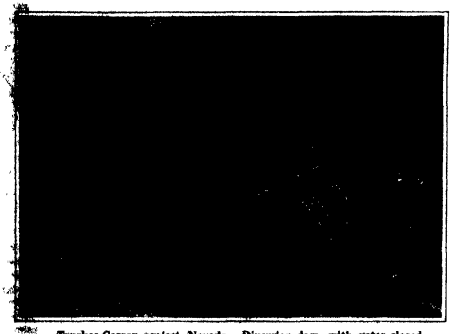
On the Huntley project in Montana, the main canal ... point where topographic conditions require ... dropped to a lower level to avoid a long ... of broken country; the power generated by ... water at this drop is utilized for pumping ... of the water to an elevation considerably ... than the main canal, which it would not have ... possible to cover by gravity. This is accom... by the device of "dry pumping" in which the ... water is received in an inclosed casing con... a large machine which consists of a turbine ... wheel and a centrifugal pump combined as one machine, on one shaft, in one casing, and the water received is divided into two parts, one of which emerges from the turbine wheel at the lower level and is thus used for irrigation, while the other portion is raised to a high level—much higher than the main canal—and used there for irrigation.

On the Yakima project in Washington a similar result is obtained by a battery of 11 large hydraulic rams.

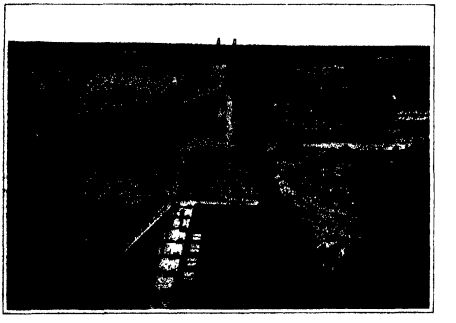
On the Salt River project the power developed at the storage dam is converted into high voltage electric current, and transmitted to the valley, where the fertile land greatly exceeds the water supply and the latter is increased by pumping from a large number of wells distributed throughout the region where ground water is known to exist. In this way about 40,000 acres of land which could not otherwise be irrigated, is added to the area of the cultivated land.

A portion of this pumped supply is utilized in relieving the needs of the Indians on the Pima Reservation, whose industry and wealth, and whose urgent needs, have been so much discussed in the public prints.

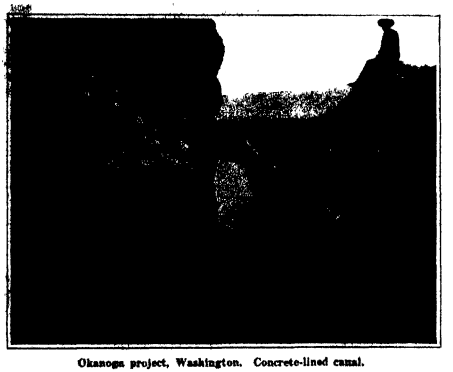
On the Minidoka project in Idaho a diversion dam about 50 feet in height has been built to divert the water upon the neighboring valleys, and about 80,000 acres of good land is thus irrigated by gravity. It is necessary to allow a large quantity of water to flow past the dam during the irrigating season, for the satisfaction of irrigation appropriations at points further down the stream. This water is taken from the dam under a head of about 46 feet, and by means of hydro-electric machinery is converted into electric current and transmitted about 15 miles to the southwestward, where it is used for pumping water from the main canal to irrigate about 50,000 acres of land too high to be reached by gravity. This is some of



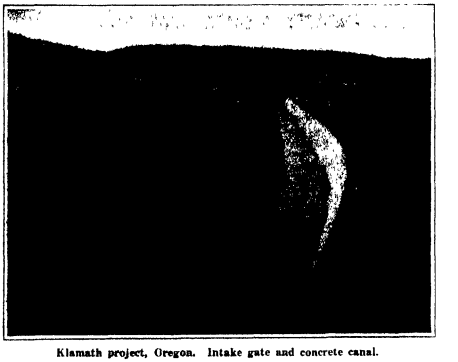
Truckee-Carson project, Nevada. Diversion dam, with gates closed.



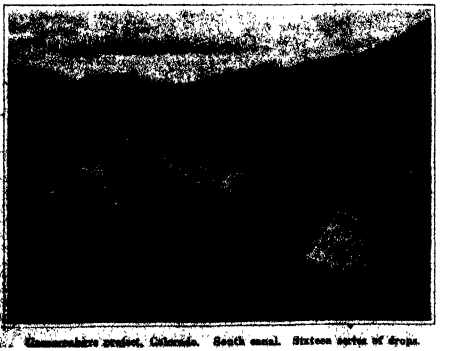
Minidoka project, Idaho. Dam and regulating devices.



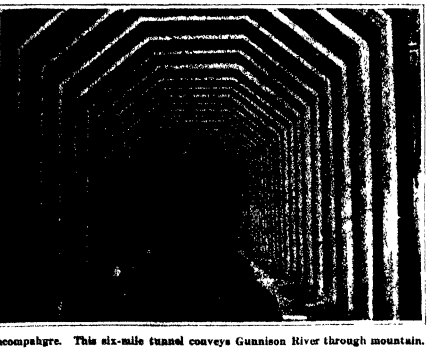
Okanogan project, Washington. Concrete-lined canal.



Klamath project, Oregon. Intake gate and concrete canal.



Uncompahgre project, Colorado. South canal. Sixteen acres of drops.



Uncompahgre. This six-mile tunnel conveys Gunnison River through mountain.

Department of the Interior, United States Reclamation Service—Results of Reclamation Work from June 30th, 1902, to December 31st, 1910.

Projects.	Irrigable Lands, Acres.				Canals, Miles.				Tunnels.	
	Estimated Total Irrigable Area of Project.	Area for Which the Works Can Be Put in Service.	Area Irrigated Season of 1910.		Primary Available Reservoir Capacity, Acre-feet.	Capacities in Second-feet.			Number.	Total Length, Feet.
			Under Water Right Applications.	Under Rental Contracts and Other Arrangements.		More than 500.	From 200 to 500.	From 50 to 200.	Less than 50.	
Arizona Salt River	200,000	150,000	...	151,000	1,284,000	62	64	54	240	26	10,800
Arizona-California, Yuma	90,160	16,000	600	8,000	...	9	...	17	81	...	...
California, Orland	14,000	14,000	...	700	40,000	...	...	38	70	...	...
Colorado, Grand Valley	56,000	...	...	...	...	...	...	...	...	...	...
Colorado, Uncompahgre Valley	140,000	80,000	...	94,000	...	12	15	41	60	6	38,314
Idaho, Boise	945,000	180,000	...	85,277	170,000	58	62	150	202	...	...
Idaho, Minidoka	196,700	101,000	35,000	11,000	58,000	12	21	119	408	...	...
Idaho Snake River Stor. Unit	...	...	...	...	360,000	...	...	...	...	...	...
Kansas, Garden City	10,677	...	...	...	...	...	...	8	5	...	...
Montana, Blackfeet	152,000	2,000	...	...	...	...	...	60	2	...	...
Montana, Flathead	188,000	10,000	...	8,000	8,460	...	...	20	118	1	974
Montana, Fort Peck	188,000	2,500	...	...	2,900	...	...	13	13	...	...
Montana, Huntley	89,881	29,805	8,000	...	...	...	9	19	135	3	3,664
Montana, Milk River	215,000	7,870	...	...	...	6	...	13	62	...	...
Montana, St. Mary Stor. Unit	...	...	...	...	...	8	...	...	...	...	...
Montana Sun River	800,000	16,300	4,000	194	...	8	1	16	100	1	884
Montana North Dakota, Lower Yellowstone	62,790	40,179	8,555	...	...	7	48	19	155	...	...
Nebraska-Wyoming, North Platte	180,000	97,630	41,096	8,196	1,095,000	20	9	44	455	3	964
Nevada, Truckee-Carson	206,000	50,400	27,095	472	290,000	23	68	79	1,295	4	2,940
New Mexico, Carlsbad	93,956	93,956	13,126	50	30,000	...	5	69	125	...	...
New Mexico, Rio Grande	10,000	...	...	1,800	40,000	...	4	8	48	...	...
New Mexico-Texas, Rio Grande	160,000	...	...	...	...	...	6	...	...	...	...
New Mexico-Texas, Lasabing Unit	...	98,000	...	98,000	...	...	...	...	...	...	...
North Dakota, Missouri River Pumping Buford Trenton Unit	12,500	4,000	440	...	...	...	...	1	14	...	...
North Dakota, Williston Unit	13,000	8,047	2,000	...	...	...	...	6	46	...	...
Oregon, Umatilla	20,000	17,000	3,000	74	80,000	...	26	24	72	1	84
Oregon-California, Klamath	127,000	80,400	37,108	...	638,000	9	...	24	98	1	3,907
South Dakota, Belle Fourche	100,000	47,488	15,410	...	70,000	7	16	65	200	1	1,508
Utah, Strawberry Valley	60,000	...	...	...	...	...	...	...	...	1	13,844
Washington, Okanogan	10,000	10,000	2,400	1,000	15,000	...	15	15	1	1	355
Washington, Yakima Storage Unit	...	...	...	...	91,000	...	...	...	...	...	...
Washington, Sunnyside Unit	100,000	85,000	6,000	45,000	...	25	15	40	260	...	...
Washington, Tieton Unit	76,000	19,978	...	1,953	...	...	19	18	119	...	10,568
Wyoming, Shoshone	160,000	34,845	14,849	352	456,709	10	9	29	166	71	16,896
Totals	5,166,643	984,736	226,836	520,351	4,588,069	341	373	932	4146	98	60,895

the driest land in the West, and for about [illegible] if the water is lifted over 90 feet by [illegible]. The power used for this purpose is generated, of course, only in the irrigating season, from April 1st to October, inclusive, and during the winter months would be available for other uses, if any such [illegible] instead; but as the community is young and [illegible] developed, there is little demand for power [illegible] when it is available only during half of the [illegible]. It happens, however, that this region is rather [illegible] from coal supply, and efforts are being made [illegible] ize the surplus winter current for heating the residences and business houses in the villages which are growing up on the project. This region promises to develop into one of the few where it is commercially feasible to use electric energy for heating.

One of the cardinal principles of irrigation is that it must be accompanied by an early system of drainage, otherwise the application of water by irrigation is likely to produce injurious effects by the waterlogging of a portion of the land, and the consequent rise of injurious alkali from great depths to the surface, where it becomes harmful to vegetation. Often it is necessary to provide artificial outlets for the drainage ditches with which each farm must be provided; and it is, moreover, impracticable to plan these to the best advantage before the exact nature of the problem has been indicated by the effects of a few years of irrigation. The varying underground conditions in the matter of porosity are shown by the actual results of irrigation, and it then becomes feasible to provide a drainage in time to prevent serious injury.

III.—Summary of the Reclamation Projects

THE following is a brief recapitulation of four signed articles written by the supervising engineers of the various projects. Unfortunately, the original articles are too lengthy for inclusion in the present issue. They are published in the current issue of the SCIENTIFIC AMERICAN SUPPLEMENT, *together with a large number of illustrations from photographs furnished by the Reclamation Service.*—ED

Washington Division. Charles H. Swigart Supervising Engineer.

The Washington Division comprises all of the State of Washington and the extreme northern part of Idaho. The Reclamation Service has completed one project, the Okanogan, and is now constructing the Yakima project. OKANOGAN PROJECT.—The Okanogan Project, now completed, provides for the irrigation of land in the valley of the Okanogan River. Water is stored in Salmon Lake, and in Conculli Reservoir, the two having a combined capacity of 15,000-acre feet. An earth dam a thousand feet long, 64 feet high, has been built across Salmon Creek. This is the only dam constructed by the hydraulic hill method by the Reclamation Service. The irrigable land, amounting to about 8,650 acres, is of volcanic ash, sand and gravel. The building charge per acre is $65, and the annual maintenance and operation charge is $2. YAKIMA PROJECT.—The Yakima Project embraces all the land in the Yakima Valley that can be watered from the Reclamation Service works, together with some lands in the Columbia Valley, near the mouth of the Yakima River. This project, for convenience, is divided into the Storage Kittitas, Tieton, Sunnyside and Wapato Units, with the High Line, including the Benton Unit, or the Benton Unit alone, as alternative propositions. The Storage Unit includes works for impounding the flood waters of the Yakima and its tributaries, in five separate reservoirs, which will have a total capacity when fully developed of approximately 928,000 acre-feet. The Kittitas Unit, for which surveys have been made, embraces 62,000 acres of land on both sides of the Yakima River. The Tieton Unit, containing some 34,500 acres, lies west of the city of North Yakima, and between the Naches River and Ahtanum Creek. The Sunnyside Unit, containing 100,000 acres, receives its water from the Yakima River, just below Union Gap. The Wapato Unit consists of 114,000 acres on the right bank of the Yakima River, just below Union Gap. This land was allotted to the members of the Yakima tribe of Indians. The Benton Unit includes from 120,000 to 150,000 acres of land on both sides of the Yakima River, near its junction with the Columbia. The High Line Canal will, if constructed, furnish water for the lands on the left bank of the Yakima River above existing canals.

Northern Division. H. M. Savage Supervising Engineer.

The Northern Division comprises the States of Montana and North Dakota, and South Dakota, and northern Wyoming, and includes the Missouri River drainage basin, with the Yellowstone River in Montana and the Big Horn River in Wyoming. Within this area the construction of seven Reclamation Service irrigation projects has been authorized. Construction has progressed to the extent that at least one unit of each project has been completed, and all the large feature structures on several of the projects are now constructed.

The flat grade of the Missouri River rendering the construction of gravity irrigation canals impossible, the construction of the NORTH DAKOTA PUMPING PROJECTS was found to be dependent upon the development of power from the ample fuel supply in local lignite beds, and its transmission electrically to operate centrifugal pumps mounted on floating barges on the Missouri River. The barges are taken out of the stream at the end of the season and again launched at the beginning of the next irrigation season. THE LOWER YELLOWSTONE PROJECT.—The Lower Yellowstone Project in eastern Montana and North Dakota covers 60,000 acres, and is nearly completed. It includes a timber crib rock-filled diversion dam, which provides an overflow depth of 25 feet. The Yellowstone River at the site of this dam has a maximum flood flow of 160,000 cubic feet per second. THE SHOSHONE PROJECT in northern Wyoming will reclaim 164,000 acres of land, with a feasible extension to cover 300,000 acres. The principal features are the Shoshone Dam, the highest masonry dam in the world (328.4 feet), which regulates the discharge of the two Shoshone rivers, and whose reservoir is now filled to the spillway, and the Corbett Tunnel, three and a half miles long, with a discharge capacity of 100,000 cubic feet per second. THE HUNTLEY PROJECT on the Yellowstone River has an area of 32,000 acres, of which 28,000 acres is now settled. The success of the Huntley settlers is unprecedented. The crops on the irrigated area the second season realized a value of $25 per acre. The project has now thirteen public schools and six church organizations. THE SUN RIVER PROJECT, west of Great Falls, is the largest in the division, the available water supply being from 200,000 to 300,000 acres. It is now entering on its third season of operation. The main features are high storage dams and a canal of 2,500 cubic feet per second capacity. THE MILK RIVER PROJECT in northern Montana depends on the waters of the St. Mary drainage basin, which discharges into Hudson Bay. It involves 100,000 acres of land, and four million dollars has recently been provided for carrying on the work. INDIAN RESERVATION IRRIGATION PROJECTS.—The Reclamation Service is constructing works on the Flathead, Black Feet and Fort Peck Indian reservations, each of which has an area of about 150,000 acres of irrigable land. Most of this has been allotted to the Indians in severalty, and the receipts from the sale of excess lands will return the cost of the irrigation works. The ultimate development of the FLATHEAD PROJECT involves the construction of fifteen storage reservoirs, and the construction and operation of a hydro-electric pumping plant.

Idaho District. J. T. Whitworth Supervising Engineer.

The Idaho District embraces that portion of the Snake River Basin from its headwaters in the Yellowstone National Park in Wyoming to its confluence with and including the Salmon River, a total area of about 90,000 square miles. It embraces the Boise, Minidoka and Snake River Storage projects. BOISE PROJECT.—This embraces 243,000 acres of land on the south side of the Boise River between its confluence with the Snake River and the city of Boise. The principal engineering features are: First, a storage dam, 1,025 feet on the crest and 340 feet high, which will be the loftiest dam in the world. It will impound 207,000 acre-feet of water for use in the low water period, on lands in the upper portion of the project. The lower portion will be supplied from the Deer Flat Reservoir, which is filled by water diverted from the Boise River, and will have a capacity of 170,000 acre-feet. The main south-side canal for carrying the water has a capacity of 3,500 feet per second, and is forty miles in length, six of which are lined with concrete. MINIDOKA PROJECT.—The principal engineering feature of this project, which embraces an area of about 132,000 acres on both sides of the Snake River in central southern Idaho, are the Minidoka Dam, headworks, power plant, and pumping stations. The dam, 736 feet long and 86 feet high, is of the rock-filled type. It is flanked by the power plants and north side headworks on the north and a solid concrete spillway 2,400 feet long, and the south side headworks on the south side. The power plant includes five turbo-generators of 1,500-kilowatt capacity, which, during the irrigation season, pump water to 47,000 acres of high land, and also serve to furnish the towns on the project with light, power and heat. Nearly all of the business houses and many of the private houses in the thriving towns of Rupert, Heyburn and Burley use electrical energy for heat. The three pumping stations on the south side lift the water in three stages to a total height of 90 feet. By means of reinforced concrete piers, the water of the reservoir can be raised five feet, thus increasing the storage capacity and the available head on the turbines. SNAKE RIVER STORAGE.—This contemplates the storage of flood water of the rivers in reservoirs, so as to regulate its flow to conform to the needs of irrigation and power. Jackson Lake Reservoir, just south of the Yellowstone National Park, is completed. A reinforced concrete dam and an earth dike form a reservoir of 850,000 acre-feet capacity.

Intermountain District. R. F. Walter Supervising Engineer.

The work of the Intermountain, sometimes known as the Central District of the Reclamation Service, covers a territory in which irrigation has been employed as a means of distributing moisture to grow crops since the earliest settlement of the Mormons, who turned their attention from the rocky, arid soil to the work of directing the waters from the streams onto the barren land. They were so prepossessed that agriculture without irrigation was impossible that they [illegible] try [illegible] and engineers the value of [illegible] waters in reservoirs, for use after the [illegible] had been reduced to flow. This work began about [illegible] since which time thousands of [illegible] acres have [illegible] cultivation [illegible]

The Conservation of Fishery Resources

How Legislation May Prevent Ruthless Waste

By Dr. Hugh M. Smith, U. S. Deputy Commissioner of Fisheries

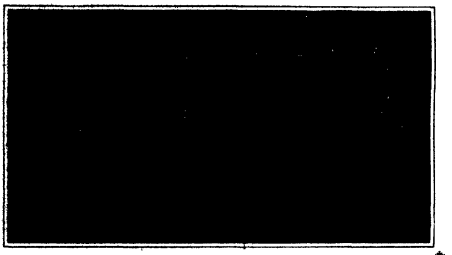
NEARLY forty years before conservation had become a household word in America, one branch of the federal government had entered on a course of action having for its direct object the maintenance of the supply of useful water creatures. That work has continued uninterruptedly and with constant augmentation to the present time, and in it the Federal Government as represented by the Bureau of Fisheries has co-operated for many years with the fishery departments of various States. Among all of our natural resources there are none that have been more flagrantly abused, none that are more in need of intelligent attention at the hands of conservators, and none that will respond more readily to decent treatment than the fishes and other inhabitants of our coastal and interior waters

Success of Fish Culture and Acclimatization.

The acclimatization of fishes in all parts of the country has been a potent supplement of fish culture proper and a valuable factor in conservation by reinforcing the strain on native fishes and by making exhausted waters again yield their quota of human food Among the noteworthy results of the introduction of fishes into a new environment are the cases of the shad and striped bass These excellent food fishes are not native to the Pacific Coast but were planted there by the government more than a quarter of a century ago. The slender colonies took root, thrived, multiplied, and spread to such an extent that both of these species are now reckoned among the commonest food fishes of the western seaboard, the shad having a coastwise range of four thousand miles and the striped bass being more abundant in California than in any Eastern State The entire cost of the introduction of these fishes into the Pacific States did not exceed $5,000. The market value of the catch to the fisherman to the end of the year 1910 exceeded $1,750,000. With the present trend of the shad and striped bass fisheries on the Atlantic Coast, it is not beyond the range of probability that the re-establishment of these fishes in eastern streams may depend on fry brought from the West.

Legislation and Regulation.

A co-ordinate if not a coequal factor in fishery conservation is legislation. For the protection of fish in interstate waters, well considered restrictive legislation, supported by local sentiment, may accomplish much; for interstate and boundary waters, or for fishes that migrate from one jurisdiction to another, legislation has often, perhaps usually, failed The failures have been serious in some regions and in the case of some species, and afford the strongest possible argument for federal control and also regulation



Catching and sorting the brood fish at a government trout-cultural station in the Rocky Mountains.



Various species of trout are hatched in large numbers, and numerous lakes and streams are kept bountifully stocked

Stripping and fertilizing trout eggs at a station in the Rocky Mountains.

An event which gave promise of resulting in one of the great conservation measures of this generation was the assumption by the federal government of jurisdiction over the fisheries of the waters contiguous to the United States and Canada from Passamaquoddy Bay to Fuca Strait, followed by the conclusion of a treaty between the United States and Great Britain under which joint fishery regulations were to be drawn up, ratified, and enforced by the two countries This assumption by our government of jurisdiction that had formerly been exercised by the States was undertaken reluctantly and only after protracted evidence of the inability of the States to enact and enforce legislation that was harmonious and adequate It is therefore very unfortunate for the welfare of these extensive fisheries that the recommendations of the special commission appointed under the treaty have not been put into effect

Whitefish of the Great Lakes.

The case of the whitefish of the Great Lakes is serious and radical action is necessary to arrest a decline that has been in progress for many years The regulations and restorative measures provided for the treaty would undoubtedly prove a boon to the whitefish fishery and would soon convert a dwindling industry into a flourishing one

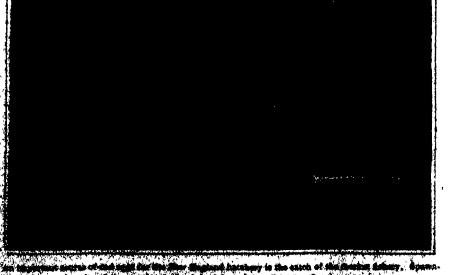
The fact that the supply of whitefish has not been maintained even at the reduced point reached in 1880 or 1890 has resulted in the direct loss of many million dollars to the fishermen and the indirect loss of many hundred thousand dollars to Federal and State Governments because of their abortive efforts to restore by artificial propagation and the enforcement of restrictive legislation There is no fish that has been hatched artificially in larger numbers than the whitefish, while enough legislation has been addressed to it to sink a battleship The catch has declined eighty per cent in twenty years, showing how powerful are the anti-conservation forces in operation

There is absolutely not a single valid reason why the abundance of this great food fish should not have remained practically unimpaired for untold generations and at the same time vast quantities have been caught for market. The average number of eggs laid by a whitefish is 25,000 All that nature required, all that the unimpaired perpetuation of the fishery demanded, and the least that common sense could have granted was that a single pair of fish from the 25,000 eggs should have been permitted to reach maturity and spawn

Oysters and Sponges.

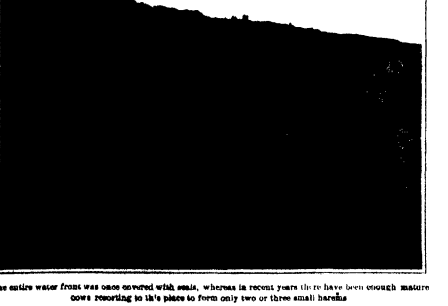
After a precarious existence of many years, the oyster has gradually come under the influence of cultivation, and along much the greater part of our extended coast its conservation is an assured fact and need never occasion any further concern The finan

(Continued on page 154)



An illustration of the kind that the fish-displayed hatchery is the catch of the Alaskan fishery. Spawn-taken from the female, fertilized therein, and now the eggs of which are hatched.

Stripping and fertilizing trout eggs at a fishing station.



The entire water front was once covered with seals, whereas in recent years there have been enough mature cows resorting to this place to form only two or three small harems

A depleted fur-seal rookery.

The Use and Waste of Our Coal Supply

(Continued from page 138.)

These problems are intricate, and their satisfactory solution doubtless remote, but they are of such importance as to be worthy of the best efforts of the Government and of its private institutions and individual citizens

In engineering and architecture we hide our ignorance as to the strength and other properties of structural materials behind the well-sounding phrase, "factors of safety" In these important and intricate fuel problems we hide our ignorance and rest our laurels concerning these losses under the equally comforting expression, "transformation of energy" What American industry needs is technical information, accurate fundamental data, such as comes from varied, extended, continuous, well directed, and scientific research

Each recent year has witnessed some advance in the line of greater fuel efficiency, and while each advance has been small, the aggregate has during the past decade raised the percentage of heat units converted into mechanical work from five or six to nine or ten, and slightly more in a few cases The gas producer and gas engine, the steam turbine, and the improved reciprocating engine, represent steps in this advance So does also the



Coal car is picked up bodily, turned over, and discharges to chute.

development and introduction of the several types of automatic stokers these latter contributing to efficiency and at the same time lessening the smoke nuisance from modern power plants

These automatic stokers and special grates have further contributed to the conservation of resources by making possible the more efficient burning of fine or slack coal which formerly was relegated to culm piles as waste and as such to be burned in the open air Briquetting is making another contribution along the same line Another step in the direction of practical conservation cleanliness and hygiene and one that should be pushed more rapidly is the location of the great power plants at the mines, and the burning there either in gas producers or specially constructed furnaces, of the low grades of coal now thrown away because they will not bear transportation, and the electric transmission of the power so developed to adjacent cities, towns and isolated plants

I look forward to a time and it cannot, I believe, be far distant when ample supplies of electricity so generated and brought into our factories and our homes will not only give us light and power, but will also cook our food and warm our houses

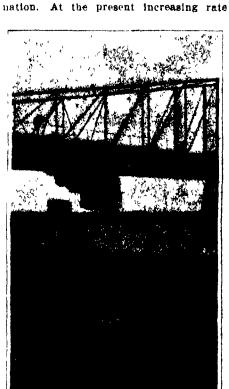
Two other marked advances in the economic utilization of coal deserve mention because of both their extent and their far reaching importance one is the large beginning in the manufacture of by product coke for the latest steel plants of the United States Steel Corporation, including the saving of such valuable by-products as creosote for the preservation of timber, and sulphate of ammonia, so largely used in the fertilising of crops. The other is the use in large gas engines of the blast furnace gases that formerly were entirely, and in many places are still largely wasted The losses in these two fields, added to the shameful waste of natural gases, still aggregate yearly from $50,000,000 to $100,000,000; but improvements are under way in all these lines

How These Mining Losses May Be Reduced.

No one questions the fact that these losses are real, nor are there any serious differences of opinion as to the proposition that these losses should be avoided Just how this best can be done is another matter, and one about which a difference of opinion may naturally arise The situation is full of interest, full of problems for the statesman the engineer and the economist, the consumer and the producer It involves the very essence, the purpose and the practicability of the movement for the conservation of resources

The case may be stated as follows:

We have but the one supply of coal, and this supply is essential to both the future and the present welfare of the nation. At the present increasing rate



Much coal is lost as dust during handling.

of use and waste of this supply, it will be used and destroyed while the nation is yet in its youth By mining and using this coal more efficiently, the life of the supply may be extended indefinitely, and both the present and future welfare of the nation thus properly safeguarded The coal operator does not practise wasteful methods by preference He is, however, operating under a system that encourages and even renders inevitable these wasteful practices, and for which system the public itself is largely responsible

A Federal statute makes it impossible for the coal producers to co-operate or combine with a view to fixing a common or non-competitive price for coal at the mine The demand for coal during the winter season of each year being much in excess of that during the warmer months, and the entire lack of storage facilities at the mines requires for this cold weather demand a mining capacity much in excess of that necessary for the summer needs Under such a system there is constantly in progress a fierce struggle for business, and a reduction to prices so low that they often fail to cover the actual cost of production—so low that safe and clean mining is discouraged and even rendered impossible Meanwhile, no two States have similar mining laws for the protection of life and property, nor will any State enact, or enforce, if it enacts, drastic legislative requirements, for if it does it thereby places its own mine operators at a serious business disadvantage in the sharp competition with operators in other States.

The remedy is easily stated, but not easily developed. The cut-throat competition should give place to a reasonable combination under such Federal or uniform State control of prices as would guarantee reasonable returns on mining investments, and require mining practices in which both accident and waste are reduced to an absolute minimum. This regulation and readjustment should be extended so as to include the freight and terminal agents' charges; and if this be properly done, safe and clean mining may be realized without material increase in the cost of coal to the ultimate consumer.

If to the American people the doctrine of conservation is a thing of substance and not a dream, if those of us who today are wastefully luxuriating in the abundance of inherited resources, have seriously at heart the rights and the welfare of those that are to come after us; if we are really in earnest about safeguarding the lives of the more than a million miners who labor underground for our comfort and welfare, we should enact and enforce the Federal and State legislation necessary for the accomplishment of these ends. We should render possible the business-like reorganization of this great basic industry. We should see to it that this underlying economic basis is sound, whether judged from the standpoint of the individual or the nation—from the standpoint of the present or future welfare of the nation.

The Vibrations of Metals

It has been contended that solid metals may reveal by their structure the vibrations to which they have been subjected. In explaining this phenomenon, experiments were made in England to show that a beautiful wave structure can be imparted to the surface of mercury by the vibrations of a tuning-fork, and that even the surface of solid lead which has been subjected to similar vibrations possesses a structure resembling that of a vibrating surface of mercury Mild steel was defined as a "solid solution" of iron and carbon, free from cinders Metallurgists have doubled the strength of steel as it was known in early days

Iodide of nitrogen a black powder, is one of the most dangerous of all explosives When dry the slightest touch will often cause it to explode with great violence

There appears to be a certain rate of vibration which this compound cannot resist In experiments to determine the cause of its extreme explosiveness, some damp iodide of nitrogen was rubbed on the strings of a bass viol It is known that the strings of such an instrument will vibrate when those of a similar instrument having an equal tension, are played upon.

In the present case, after the explosive had become thoroughly dry upon the strings, another bass viol was brought near and its strings were sounded At a certain note the iodide of nitrogen on the prepared instrument exploded

It was found that the explosion occurred only when a rate of vibration of 60 per second was communicated to the prepared strings Vibration of the G string caused an explosion, while that of the E string had no effect.

The question is often asked, What force least expected does the greatest damage to buildings? One architect's answer to this question may be a surprise to those who do not understand that it is the regularity of vibration that makes it powerful

"I venture to say," remarked this architect, "that you would never suspect that violin playing would injure the walls of a building Yet it certainly does. There have been instances when the walls of stone and brick structures have been seriously damaged by the vibrations of a violin. These cases are, of course, unusual, but the facts are established.

"The vibrations of a violin are really serious in their unsuspected, unbounded force, and when they come with regularity, they exercise an influence upon structures of brick, iron or stone. It follows, of course, that there must have been continuous playing for years to cause the loosening of masonry or to make iron brittle, but it will do so in time."

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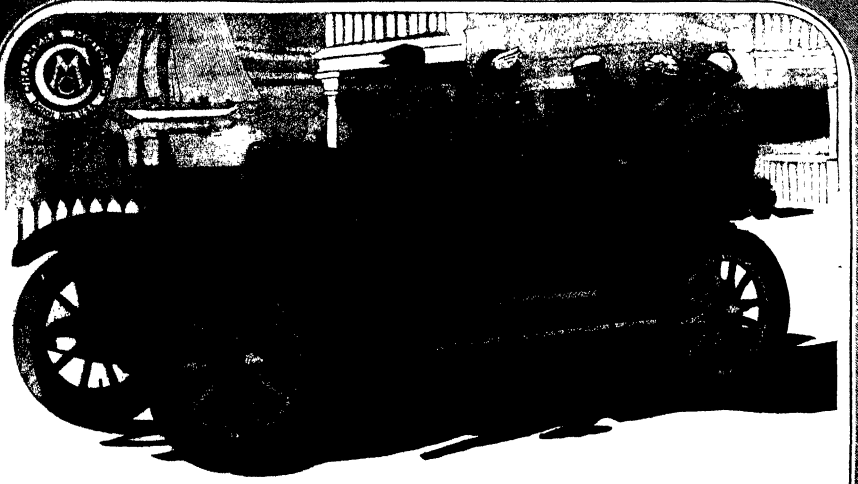
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This New, Big, Self-starting Chalmers "Thirty-six"—$1800

THINK of a new, high powered Chalmers car with a Self-starter as regular equipment—for $1800! No more cranking, no more bother. Just push a button on the dash with your foot, and away goes your motor.

That isn't all. This car has a long stroke motor (4¼" x 5¼", developing 36 to 40 h. p.); four forward speed transmission; Bosch dual ignition; 36-inch by 4-inch tires; Continental Demountable rims; Mercedes type honeycomb radiator; dash adjustment for carburetor.

Furthermore this car has bigness, strength, proved durability, beauty, fine finish, comfort. Still further, it is a *Chalmers* car. On the radiator is the famous blue and white monogram.

And the price, including all these unusual features of value, is $1800.

A man at the circus for the first time viewed in amazement the giraffe. After looking the animal over for some time and inquiring if it had a name, he turned shruggingly away saying, "There ain't no such animal."

Many motorists, hearing of the Chalmers "Thirty-six" for the first time, then learning the price, have felt much the same way.

But they are wrong. There really is such a car as the Chalmers "Thirty-six," with the features named above—for $1800.

You can see this car now at our dealer's store near you. And it will look better to you there than it does in this advertisement. See it. Ride in it. Place your order as early as you can because there is sure to be an over-demand.

Ideal Car for the Farmer

This is an ideal car realized. A car perfectly adapted to the needs of the up-to-date farmer. The long stroke motor gives all the power and speed you can want, without useless burning of gasoline. The four forward speed transmission gives perfect flexibility for hills, sand, traffic and straightaway. Big tires, 36-inch by 4-inch, give riding ease and insure low tire upkeep bills.

The "Thirty-six" is heavy where weight means maximum strength, but there is no useless weight. We claim that this car is lighter than any other car of the same power, roominess and strength, and that it is stronger than any other car of the same weight.

This car overcomes the inconveniences of all preceding cars. The Chalmers Self-starter, air pressure type, does away with the trouble of cranking. Big tires and Continental Demountable rims rob punctures of their terrors.

Given Severe Tests

While the "Thirty-six" has every up-to-the-minute improvement, still there is not a single untried principle or part in its makeup. In November, 1910, we started three of these cars on the road to test them—one in the mountains of Pennsylvania, one in the sands and heat of Florida, and one in the varied conditions of the Middle West. They were run an average of 10,000 miles each before we O. K.'d the model for manufacture

Here is a big car—big radiator—big hood—big wheels and tires—big body with big roomy seats—big, strong frame—big axles—big all over, and yet it isn't a cumbersome, costly upkeep car

Not only has this car all of these unusual features of construction and convenience, but with them it has beauty. It is a *fine* car.

Compare With Many Cars

There are bigger cars than the "Thirty-six" and smaller ones. Cars of more power and of less. Heavier cars, lighter cars. There are higher priced cars and lower priced cars. And yet we ask you to consider this car on the basis that it is the most nearly ideal car for the farmer of all that are made.

Take the size, the power, the conveniences, the construction, the comfort, the beauty *and the price* into consideration in comparison with the same features on all other cars, and see if you do not conclude that in the Chalmers "Thirty-six" we have come most nearly to realizing the ideal car for the greatest number of people.

A Vote of Confidence

Public announcement of this car was first made on July 6th. Prior to that date, dealers had signed contracts for all we can make They were anxious to sign up for twice the number, but we had to allot just so many to each territory Since our announcement appeared, the Sales Department has received requests from more than two hundred other dealers, asking for the privilege of handling the Chalmers line in their section.

We asked dealers this year for exclusive representation for Chalmers cars in their price classes. Not one dealer was unwilling to grant this request, dozens of them giving up other lines in order to hold the Chalmers The vote of confidence which experienced dealers have given this new Chalmers car is one of the best possible guides for the individual buyer.

"30" Fully Equipped, $1500

The Chalmers "30" and Chalmers "Forty" are continued for 1912 and offer greater values than ever before because of the improved methods of manufacture and added equipment. The "30" sells for $1500, including magneto, gas lamps, Prest-O-Lite tank, Chalmers mohair top, and automatic windshield Last year this car so equipped brought $1750 The "Forty" sells for $2750, including the same complete equipment

More than a year ago, as the heading of an advertisement, we used an expression which was frequently heard in automobile trade circles "This Is Another Chalmers Year" It was true then, and we repeat it now, for it is more apparently true now than in any other year "This is another Chalmers year."

1912 catalog will be mailed on request.

Chalmers Motor Company, Detroit, Mich.

The Inventor's Department

Simple Patent Law; Patent Office News; Inventions New and Interesting

The Millionth Patent

By William N. Taft

UNMARKED by any pomp or ceremony and with a lack of ostentation that seemed totally inappropriate to the importance of the occasion, the one millionth patent was issued on Tuesday, August 8th.

The wheel of chance which decided the recipient of the epoch-making patent—for the record number was awarded to the patent which happened to be on the top of the pile when the numbering machine passed the 999,999 figure—decided in favor of Frank H. Halton, of Cleveland, Ohio, who had applied for exclusive rights to manufacture and sell an improvement on inflated automobile tires. It was fitting that this patent, in itself a monument to progress, should have been awarded to an improvement on the automobile, for there is probably no single resent invention which has done so much to mark American progress or to show the world the prosperity of the United States.

The presentation of the patent was marked by a most undue democratic simplicity. It was thought at first that there would be no official recognition of the event at all, but Mr. Halton came on from Cleveland to receive the patent at the hands of Commissioner Moore. The fact that the Secretary of the Interior had made plans to tour the reclamation projects of the West during August precluded his attending the presentation of the patent, and he evinced much disappointment at not being able to be present.

The mere statement that the issue of patents has passed the million mark is, in itself, enough to provoke wonder, but a comparison of the number of patents issued in other countries—centuries older than the United States—brings to light many interesting figures. France comes nearest to the United States in the number of licensed inventions, 430,000 being approximately the number of her patents. Great Britain is next with 416,000; Germany has issued 236,000, Belgium, 228,000, Canada, 126,000, Italy and Sardinia, 94,000, and Austria-Hungary, 68,000. All the other countries of the world have issued less than 60,000 patents each, so that the United States may easily be said to have licensed more inventions than any two nations put together, and that her total exceeds that of Great Britain, Germany, Belgium and Italy by several thousand.

Perhaps it is because the "American" is truly a cosmopolite, a mixture of all the bloods of the world, that this nation has so far surpassed others in inventions, but true it is that the majority of the important discoveries of science and the greatest labor-saving machines first saw the light of day in the United States and that the documents granting their inventors the exclusive right to manufacture and sell them are to-day reposing in the Patent Office at Washington.

Among the historic documents in the Patent Office library are the specifications and models for the steamboat, the telegraph, the telephone, the cotton gin, the mowing and reaping machine, the improved automobile, the aeroplane, and countless other machines the invention of which has lightened the labor of the world and improved its method of locomotion, correspondence and living to an almost incalculable degree.

There exists in the Patent Office library at Washington the first patent ever issued in this country, shortly after the close of the Revolution. It is a queer document, this first patent, quaintly worded and with many a turn and twist of chirography peculiar to our forefathers. It was issued to Samuel Hopkins, July 31st, 1790, for a device for making pot and pearl ashes. The archives of the department show that the issuance of a patent in those days was a state occasion. The President and cabinet met in solemn conclave and, after having deliberated upon whether it was proper for the inventor to have the sole right to the manufacture of the child of his brain, presented him with the papers bestowing this privilege upon him. Hopkins was warmly congratulated by President Washington and the event was recorded in all the diaries of those present.

Thus it was for some time afterward. Every inventor had to submit his appeal for a patent directly to the President, and it was acted upon by the entire cabinet. The consequence was that patents came few and far between and the year 1790 saw only three of these documents issued. Besides the one to Hopkins, one was granted to Joseph S. Sampson for the manufacture of candles and the other to Oliver Evans for the manufacture of flour and meal. All three of these were issued and signed by George Washington. Several other patents were issued and signed during the administration of the first President, but the records are not clear as to their number.

Washington, himself a patron of the arts, was liberal and generous in his rulings concerning the issuance of patents, but President Jefferson, fearing that government grants might have the effect of promoting private monopolies, was particularly strict in his censorship of patents.

Dr. William Thornton, an Englishman by birth, and formerly a clerk in the State Department, was the first Superintendent of Patents appointed. It was his duty to see that all the applications for patents were made in the proper form and that it was right that they should be granted. The actual issuance of the papers, however, was still retained in the hands of the President and the cabinet. Dr. Thornton's salary at the time he was first appointed was $1,400 a year. His term of office dated from May, 1802, and lasted twenty-four years.

The Patent Office as it exists to-day was established by an act of Congress of July 4th, 1836, and the first Commissioner of Patents was Henry L. Ellsworth, of Connecticut. It was coincident with the establishment of the Patent Office that the searching system came into vogue. This consists in looking through all the files of the office to see if any patent similar to the one applied for has previously been granted. This had not been done previous to 1836, as no adequate force had been available to perform the work.

The year 1836 also marks the commencement of the present series of patents, numbered consecutively. Before this time 9,902 patents had been issued, but no record had been kept of their consecutiveness. These were, therefore, disregarded in the establishment of a new system and the first patent of this series was awarded to John Ruggles, July 13th, 1836, for a locomotive engine. It is rather a strange coincidence that Patent No. 1 and Patent No. 1,000,000 should both have been awarded to improvements in the foremost modes of locomotion of their times and that these inventions mark the progress of two machines which represent the highest form of power transference then known.

From 1836 to the present time the number of patents issued has been steadily increasing until at the present time it is not unusual to see from 500 to 700 issued during a single week. An example of the enormous increase in the number granted can be found in the fact that Patent No. 500,000—awarded to E. S. Hyde for an improvement on sewerage—was issued on June 20th, 1893—only eighteen years ago! Thus it took fifty-seven years to accumulate the first half million patents and only eighteen years to gather the last half million. Truly is this a wonderful growth, both in inventive ability as well as in recognition of this ability by the government, for in the first two decades of the system very few patents, comparatively speaking, were issued, the Jeffersonian prejudice against government aid of private monopolies not having died.

For each patent issued the government charges a fee of $35—$15 upon the filing of the application and $20 upon notice that the same has been granted, regardless of the length of the specifications or the complexity of the invention. That this charge is extremely reasonable may be seen from the fact that every patent of the million and more stored away in the vaults of the department has to be gone over to discover if the application will conflict with any existing patent, or if the idea is such that a patent cannot be granted on it. This work, through a complicated system of filing, is to-day rendered comparatively easy, though two decades ago it was considered a tremendous task, although the patents were not half so numerous at that time.

From the first Superintendent of Patents in 1802 to the present Commissioner of Patents is a long step. Many changes have taken place during this time, but it is considered that the Patent Office to-day presents an example of a highly specialized and finely organized institution where the papers relating to any patent may be secured at a moment's notice and where there is not much difficulty in discovering whether an invention has been patented before or whether there is any other difficulty in the way of its being patented at the present time.

When the first patent was issued the President of the United States made the grant, as we have seen, while the record was written by a clerk in the State Department. Then followed the Patent Board, composed of the Secretary of State, the Secretary of War and the Attorney General. This was continued until 1836, when the first Commissioner of Patents was appointed, and this office has remained in force until the present day, Edward Bruce Moore being the present occupant of the chair.

Mr. Moore has worked his way up to his present position from the ranks. His first position in the Patent Office was that of Patent Examiner, in 1883, and he has remained constantly in the service of the department from that time to this. Before being appointed to his present position he was sent as a special commissioner to the Paris exhibition of 1900. In 1907 he was appointed Commissioner of Patents and was sent as the special representative of the United States to the International Conference for the Protection of Industrial Property in Stockholm, Sweden, in 1908. He also served in a like capacity at the Fourth International Conference of American States at Buenos Aires, Argentina, in 1910, and was the presiding American official at the recent International Patent Conference, held at Washington.

Notes for Inventors

A Laborer's Fireless Cooker.—A workman in a western city recently made an ingenious application of the laws of chemistry to his own purpose. A few minutes before noon a laborer on one of the big buildings then being constructed, proceeded to heat his coffee for lunch without the aid of a fire or even the use of a match. He took a bottle from his pail, and with it went to the wooden contrivance in which mortar was mixed. He put about half a shovelful of sand in a corner of the mortar-bed, having previously scraped that part of the bed dry and clean. Then he took a piece of lime about as large as his two fists. He pushed the lump of lime down into the yielding sand, put his bottle upright on the lime, banked up the bottle with sand to hold it in position, and was ready for the important part of the work. Dipping about a pint of water from a barrel near by, he poured it on the molded sand easily, allowing it to percolate through the coarse grains. Putting on a little more sand to hold the bottle in position, he went back to his work. In ten minutes the noon whistle blew, and the laborer went to his fireless heater, took from it his coffee, boiling hot, in a bottle that had at no time been in danger of breaking in the heat, and proceeded to enjoy his meal.

The Lure of Invention.—The lure of invention is one that influences all people and spares no class or condition of men. From the clergyman in his study to the convict in his lonely cell, it exerts its attraction, and both are found enrolled among the list of patentees, although not so precisely identified. The stimulus is not always the hope of fee or reward, for we find the millionaire as strongly interested as the very poor. There is something in the attraction that cannot be resisted. Someone has said that writing is like flirting. If you cannot do it, no one can teach you to do it, and if you can do it, no one can keep you from doing it. So it is with invention; no one can teach you to do it, and if you have the divine afflatus, no one can prevent you from exercising it. This is fortunate; for the inventor is subjected many times to discouraging influences in the first instance. Have you ever noticed, however, the pride with which anyone will display an invention even of the simplest character? Surely this is commendable, for we all admire originality, and invention is originality, often of the highest order. While the lure may be regarded apart from the results, we cannot help realizing what a poor world this would be except for the beneficent works of the inventors of all times.

A Swimming Apparatus.—John G. Alfter and Manuel J. Mancos of Oakland, Cal., have patented No. 998,146, a swimming appliance, in which a harness is applied to the swimmer and carries at the back, near the shoulder blades, pivoted paddles which are connected up by means of cords with the legs of the user, so the motions of the legs in swimming will also operate the paddles.

A Cooper Hewitt Patent.—Peter Cooper Hewitt of Ringwood Manor, N. J., assignor to Cooper Hewitt Electric Company of New York, has issued patent No. 998,175, for improvements in the starting and operating of mercury vapor apparatus, in which is employed an hermetically sealed and completely exhausted container with a number of electrodes in it, including an anode and a vaporizable reconstructing cathode with a platinum wire sealed to the wall of the container and lying above and below the surface of the wall of the electrode, with a starting band outside the container with current supplying means and means for applying a momentary high-voltage impulse to the electrodes to accomplish the starting.

Mercury to Weight a Fishing Line.—Fishermen will be interested in a fishing line which has mercury incorporated in its texture in order to increase the weight of the line. The patent is No. 998,341, and was granted to a resident of Bow Skydding, England.

A Self-protecting Check.—A self-protecting check is shown in a patent, No. 998,382, to Arthur J. Fulmer of Grosse Pointe Farms, Mich. The check has a number of separate signature spaces, and a different inking substance for each space.

on the different spaces, so the signature of the drawer of the check on any space will indicate that the amount of the check is not above the amount inscribed on such space.

The Need of Bats and "Billies."—There appears to be a call for better baseball bats and improved batons or "billies" for police use. Only a few weeks ago the property clerk of one of our large cities was complaining of the breaking of the police batons when used upon the head of a resisting prisoner or when rapped upon the pavement, and now Hans Wagner, the popular baseball professional, is quoted as saying "A perfect bat has never been made and never will be." Now he may be right as to what has been, but he is rash in his prediction, for none can say what may be. It is possible that future improvements in the national game may be most pronounced in the equipment of the bats and balls

Wanted: A Sounding Buoy That Will Sound in Still Water.—A sounding buoy which will sound when the water is still would be an important improvement. Such buoys, whether of the bell or whistle variety, are caused to operate by the movement of the water In foggy or thick weather the water is usually still, and the buoys will not be caused to sound. Manifestly, the buoys are more useful in foggy or thick weather than when the weather is clear Some of these buoys are large and heavy, weighing as much as twenty tons, the size and weight being necessary to compress the air for operating whistles whose tubes are sometimes as large as eighteen inches in diameter and for storing the carbide to furnish the gas for the light, the buoys being frequently combination sound and light buoys. While the problem may be somewhat complicated, it does not seem unreasonable to think that a buoy may be provided which will sound by the movement of the water in a high sea, and will also sound when the water is comparatively still

A Woman's Score-sheet for Pivot Bridge.—A woman's interest in bridge is shown in a patent, No 998,167, issued to Alice N. Gardiner of Haverhill Mass for a pivot bridge score-sheet which has two fields, one of which is divided into sections corresponding in number to the number of players, so the names of the players and the totals of the respective players may be placed in the separate sections, while the other field is divided into sections corresponding to the predetermined number of rubbers, each of such sections receiving the score for one rubber and the name of one of the players

A Peculiar Patent Claim.—As an instance of peculiar claims, a recent patent No 998,156, for a blue vat dye, is interesting The first of the claims of the patent reads "The herein described new dyestuffs having *probably* the following general formula," followed by a formula, while the second claim reads "The herein described new dyestuff having *probably* the formula," followed by the formula The use of the word "probably' in the claims seems an unusual one, but possibly the invention was one difficult to define in conventional terms

Metal Culverts.—There is considerable activity in metallic culverts, and Charles A. Foster of Portland, Ore., has patented, No 997,382, a culvert structure having a number of culvert sections secured together side by side and in which a transversely corrugated base plate has upturned side flanges and an intermediate flange, and arched top members each engaging the intermediate flange and a corresponding side flange. Mr. Foster has also issued a culvert patent, No. 997,383, including a spiral form of abutment comprising a plurality of complementary corrugated plates which are flanged for connection with the culvert.

A New Knight Patent.—A German automobile paper contains a notice of a new Knight valveless or sleeve valve engine, whose novel feature appears to be in the arrangement of the inlet and outlet ports on the same side of the cylinder and in such position as to open both said ports into the head above the extreme working stroke of the engine We are not aware of the issue of a United States patent for the improvement. The mere opening of both ports into the head appears to be ah wn n the English patent No 16,289, of 1909 although n such patent the ports are located on opposite sides of the cylinder

A Matter of Clothing.—Is there any reason why we Americans, admitted to be the most ingenious people in the world should suffer as our men do in the summer season because of our unreasonable style of dress? Notice a group of men and women in summer while the women are attired in their cotton or linen garments the men will have on coats as warm as those worn by many women in the depth of winter No one has as yet been able to devise or suggest any acceptable summer dress for men, who continue summer after summer to fwelter in warm woolen garments Is this not a fit subject for invention?

A Telephone Repeater —William Anderson of Longdale, Okla , has patented No 997,584, a telephone repeater, in which a repeater is in the telephone circuit and is automatically operative in either direction of transmission The repeater includes two transmitters and two receivers and two inductoriums The transmitters are connected with the primaries of the inductoriums and the receivers being connected with each other are also connected with opposite secondaries of the inductoriums

A Starting and Alighting Gear for Flying Machines.—Matthew B Sellers of Baltimore, Md who has given much time and thought to aviation, has just secured a patent, No 997,860, for improvements in flying machine The machine has a series of planes arranged in stepped form and yieldingly supported at their rear edges and the chassis has both wheels and runners the wheels being held in a relatively low position in starting by means including connections with the draft devices and the wheels are automatically released and lifted after the machine leaves the ground and held elevated relatively to the runners, so the machine may run on the wheels in starting and will alight on the runners

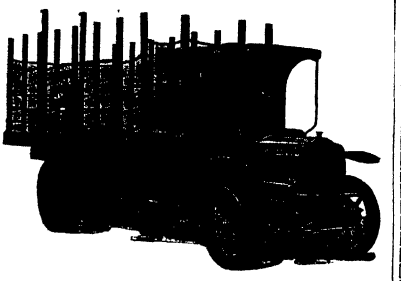
An Edison Phonograph Improvement.—Thomas A Edison has in a patent, No 996 625 provided a new phonograph reproducer seeking to avoid the friction of the stylus sliding over the record by making the stylus in the form of a roller or ball and rotatably supporting the ball so that it will press upon and roll along the record surface The patent also provides a support for the stylus which enables it to rotate with a minimum amount of friction.

Legal Notes

Foreign Words as Trade-marks.—In passing upon the registrability of the Spanish word Elegancia" as a trademark for wine the Commissioner of Patents in *ex parte* Julius Wile, Sons & Company resterates the well-settled doctrine that the foreign equivalent of a descriptive word is not registrable

The Commissioner's Powers Defined — In the case of Cosper v Gold and Gold and Cosper v Gold, the Court of Appeals of the District of Columbia has held that where in an interference involving more than two parties the Commissioner of Patents decides that one of the parties is not the first inventor, such decision is final, but is appealable to the Court of Appeals of the District of Columbia, also that where the Commissioner affirms a decision dissolving an interference on the ground that one of the parties thereto has no right to make the claims, the Commissioner had jurisdiction to enter an order that such party is not the first inventor.

Mandamus and the Commissioner.—The Supreme Court of the District of Columbia by Justice Barnard has just decided in the case of Lang v. Moore, Commissioner of Patents, that where a claim was finally rejected which was not identical with the claim presented, but which the Commis-



Possibilities of Motor Trucks Unlimited

THERE is practically no limit to the possibilities of motor-driven trucks in the business world. Every man who has a cartage problem must feel a personal interest in knowing The White Company have hundreds of trucks in operation in almost every conceivable kind of business—under practically every known condition—and there is not a single owner to whom we could not refer a prospective buyer—not one but has found White trucks to exceed his expectations.

Increased Service White trucks serve their owners, first of all, by increasing the service They make it possible to do things you have never done before—to secure trade you were unable to reach—to be prompt where you were compelled to be dilatory before—to increase your service and thereby increase your business.

Increased Economy Under the majority of conditions, White trucks increase the economy of your delivery—not always—there are conditions where trucks only increase the service. The truck replaces two or three teams—is not as expensive to maintain as two teams and requires no more men to operate than one team, saving salaries

White Trucks—The Solution

White trucks secure these results because they are well designed for economy's sake, having a long-stroke, medium-bore engine, which is powerful while economical. They are built for economy's sake because the best materials modern science has produced is used in them—the special alloys of steel, heat-treated, that are best suited to each of the various purposes to which they are put. White trucks, made in three sizes, with standardized engines in all types, are adapted to any business, any special or unusual requirements.

Let us submit a solution of your delivery problem, with catalogue and testimonials of the world's largest users.

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838 East 79th Street, Cleveland

DAHLSTROM
METALLIC DOORS and TRIM
bring forth a powerful editorial from a great newspaper

THE PHILADELPHIA EVENING ITEM

The Phila. Evening Item.

SIXTY-FOURTH YEAR.

"The Paper of the People."

Progress in Fire Protection

Philadelphia, Pa., [illegible]

We are in receipt of a kind letter from the Rochester (N. Y.) Chamber of Commerce, by its President, Albert R. Eastwood, in which we are accorded all the appreciation by that body "of your splendid editorial entitled, 'Public Rising to Prevent Fires' " " That the "Rochester Chamber of Commerce or by that editorial stimulated to carry on this work aggressively, not permanently, for the country at large, but for the results to be obtained within the limits of the City of Rochester.

"If our example will disinfect other communities to like activity, this stupendous fire waste can be somewhat checked."

We reproduce that letter in part as an instance of a popular uprising among the business interests all over the country to reduce our enormous fire losses, losses which the present year shows to be largely on the increase.

In connection with this subject we have just received, with the personal compliments of its author, F. W. Fitzpatrick, consulting architect formerly of United States Bureau, etc., entitled, "Fire and Fire Losses," a handsome work most carefully prepared for instructive purposes.

Mr. Fitzpatrick says fire is the most dreaded of devastators; "it has been used in war for destroying weapons, and in its crude state, so to speak, as an auxiliary which ranks with carnage and rapine.

"In the form of conflagration, it has supplied some of the most spectacular and memorable and saddest events in history."

Mr. Fitzpatrick very properly puts the weight of his argument for fire prevention upon the fire-resisting construction of buildings.

In connection with that conclusion, which is practically unanimous among those who have made a study of the matter, we recently gave considerable time to a consideration of the recent development of using drawn steel in the place of the interior wood work of dwelling and office buildings, and for interior furnishing to both classes of buildings, and for interior railway car work.

To be frank about it, we were greatly astonished at the BEAUTY, STYLE AND FINISH OF THIS STEEL INTERIOR WORK, which is now in use aboard steamships for storerooms and other interior work, as well as in the other cases above mentioned.

This interior steel work cannot be detected by visible inspection. It so closely resembles the finest wood work, both in design, grain, rounded edges, and jointed ornamentations, that the occupant of a room so fitted up would not suspect, were he not told, that he was not surrounded by the finest wood work procurable.

Then, too, this steel interior work is used for practically every purpose—flooring excepted—for no plain woods are used for.

Of course, it is fireproof, will not burn, and overcomes that complaint of fireproof building constructors who have said "How can we make a building fireproof when its occupants fill it up with inflammable furniture?"

For window frames, doors and frames, wainscoting, walls and ceilings, and all interior work this DRAWN STEEL IS MADE AS BEAUTIFUL AS THE FINEST CABINET FINISH OF THE BEST TROPICAL WOODS. And far more beautiful artistic work is possible in shaping this steel than could be worked out in wood.

In fact, artistic designs in this steel as beautiful to-day as they are in study and practice are in their infancy

* * * * * * * * *

The preceding excerpt can give but the faintest idea of the beauty and utility of the Dahlstrom Products.

We are the originators of this class of work and have developed drawn steel construction to its highest efficiency. The Dahlstrom Products are to be found in the structures exemplifying "fireproof reality" such as The Singer Building, New York, William Hunter High School, Philadelphia, First National Bank Building, Denver, Amicable Life Insurance Building, Waco, Texas, U. S. Battleships Florida and Utah, and so on

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(7)

alone decided did not differ in principle or substance therefrom, the Commissioner was exercising his judgment within the discretion and judgment and authority given him, and that the Court cannot in such case compel him to reverse such judgment, even if erroneous, by issuing a writ of mandamus.

The Conservation of Fishery Resources

(Continued from page 185.)

cial and other benefits of oyster culture, as contrasted with the primitive methods that formerly prevailed, should appeal to the few States that insist on doing nothing and are satisfied with letting their oystermen follow the same course that their grandfathers did, regardless of the depletion of the grounds and the neglect of the opportunity to reap large revenue from the sale or lease of barren or exhausted bottoms.

The valuable inshore sponge grounds on the Florida coast long ago became exhausted, and the fishermen were obliged to extend their operations into deeper and deeper water. This condition was brought about by the activity of the operations the demand for sponges, and the indifference of the State. To make bad matters worse, a new destructive element was introduced into the fishery at the most inopportune time for the conservation of the sponge supply. The decline of the sponge fisheries in the Mediterranean Sea, and the interdiction of the use of diving apparatus in some parts of the sea, threw many spongers out of business and resulted in a great influx of Greek divers to the Florida coast. These people have shown no regard for the ultimate welfare of the fishery, and have not hesitated to violate a Federal law for the protection of the industry, so that the present outlook is grave.

In order to make possible the re establishment of sponges on depleted grounds as well as to encourage the raising of sponges as a private enterprise, the Bureau of Fisheries has devised a method of growing sponges from cuttings that is susceptible of commercial application and should be extensively availed of when the State grants to sponge cultivators the proper measure of protection.

The Decline of the Lobster.

In spite of the most active possible hatching operations conducted by the Federal Government at three stations on the New England coast, and notwithstanding perennial attention from the State legislatures the lobster has declined to an extent that causes much concern among those most interested in the welfare of the fisheries. This most valuable of our crustaceans reached the climax of its importance in 1889 or 1890 since which time there has been no interruption to the annually diminishing catch, while the price has steadily advanced. The immediate cause of the decline was the absolute disregard of the lobster fishermen for the welfare of the species. There is no set of fishing laws that has been more systematically, ruthlessly, and unanimously violated than those designed to protect short lobsters and egg-bearing lobsters. These laws have been admirably conceived execrably enforced. There is scarcely a hotel or boarding-house on the entire New England coast that has not had illegal dealings with the lobster fishermen. I have personal knowledge of a State fishery official who encouraged lobster fishermen to bring him short lob sters for his table. I have heard of a United States senator who secretly bought lobsters illegally caught.

Water Pollution.

One of the strongest anti-conservation agencies is the pollution of water by industrial wastes. In thousands of localities insignificant factories or mills have been permitted, if not encouraged, to discharge their refuse into a stream, thereby polluting not only the immediate vicinity but many miles below, and driving out or killing every living thing. What can compensate a community for the fouling of the waters and banks of a beautiful stream or lake? In the long run, a trout or bass stream is of far greater value to a neighborhood than is a mill that pours noxious substances into that stream. This is of course true in the æsthetic sense, but the scientific basis of the controversy, namely, that a polluted stream is a dangerous source of typhoid, food, and recreation to a community. Industrial establishments can and should be conducted without injury to the fishes and other inhabitants of the water-courses on which located. Some of the States have fully recognized this, and have enacted and enforced anti-pollution laws without harm to legitimate business interests; but there is still need for a country-wide crusade against the desecration of public waters and the senseless destruction of useful aquatic creatures.

The Alaskan Fur Seals.

When the Pribilof Islands came into the possession of the United States in 1867 as a part of Alaska, the fur seals thereon, it has been variously computed, numbered from 2,000,000 to 7,000,000, with 4,000,000 as a safe estimate. At the close of the season of 1910 the herd consisted of less than 135,000 seals of all ages. During this entire period the government exercised absolute jurisdiction over the herd while on land, and partial jurisdiction while in the water, and it is therefore the opinion of many people that the government is responsible for the present precarious condition of the herd. This, however, is true only to the extent that the government failed to secure international agreements by which the seals would have received adequate protection while at sea.

It is now universally appreciated that the decline of the fur-seal herd was coincident with and dependent on hunting at sea. The early efforts of the United States government to prevent pelagic sealing in Bering Sea culminated in the arbitration proceedings at Paris in 1893. The award of the arbitration court was against the United States in both of the main contentions, namely, that Bering Sea is a closed sea and that the property right in the seal herd warranted the government in protecting the seals while on the high seas. Since the award of the Paris tribunal, the case of the fur seal herd has gone from bad to worse.

Pelagic sealing is a cruel, wasteful, wholly unjustifiable business that can only be prosecuted in flagrant disregard for or indifference to the question of the perpetuation of the fur seal as a commercial animal. The preponderance of the pelagic catch consists of pregnant mother seals which have left their nursing pups on shore and gone to sea to feed. The killing of every cow seal therefore involves the loss of her unborn offspring and her pup on shore, which inevitably succumbs to lingering starvation, to say nothing of the cow's potential productivity, which may extend over a period of ten years or more. In all of its aspects pelagic sealing is repugnant to one's sense of decency and propriety. Our interests are largest and we have suffered most, but Japan and Russia have also had their herds depleted and almost wiped out by foreign or domestic hunters and raiders.

Notwithstanding that only a remnant of the once mighty fur-seal hosts is left, it is believed that the outlook for the preservation and restoration of the herd is more propitious than at any previous time. This optimistic view is based on the facts that the administration of the seal islands has recently been vested in the Bureau of Fisheries, where the fur-seal service logically belongs, and where it should have been years ago; that the seals are now receiving what they never before had, namely, continuous scientific supervision on which the conduct of the commercial features of the business will depend; and that under the authority and direction of an enlightened Secretary of Commerce and Labor the affairs of the seal islands will continue to be conducted with regard for both seal herd and government, whose interests are necessarily identical.

The most important augury for a new and improved dispensation for the fur seals is afforded by the treaty recently concluded between the United States, Great Britain, Japan, and Russia, by the terms of which the killing of seals on land will be continued at the discretion of the respective governments that are custodians of the seal herds, while all pelagic sealing will be prohibited for at least fifteen years—and let us hope forever.

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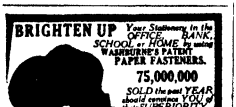
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Photographs in Railway Work

THE uses of photography are constantly extending. A western railroad has uses for it as a substitute for written reports on construction work For example, the progress of the work of changing a grade crossing or building a bridge is photographed at stated periods, and the photographs are preserved both as a record and as illustrations of method Pictures are also taken of all the resources of the road in the way of material, and of every mile of track, showing curves, grades, switches and crossings A complete set of photographs is used, too, to illustrate the book of rules which is placed in the hands of every railroad man This enables the men to refresh their memories by reference to the view of any particular point on the road, and makes them more readily interchangeable from one division to another The book of rules also contains photographs of trains in more than one hundred combinations of circumstances, and the text informs the trainmen what to do in each case

The "Talking" Picture and the Drama

By Robert Grau

IT was my pleasure to be among those in the audience at Keith's Union Square Theater, in New York, one evening in July, 1894, the eventful night when the motion picture was first revealed to American theatergoers. It is true that an inferior device under the name of Eidoloscope had previously made a feeble effort to introduce, also in a Keith theater (in Philadelphia), the effects which were destined ultimately to change the theatrical map, and to create the most lucrative field of endeavor in the history of public entertaining

The advent of Lumière's cinematograph was announced with much advance advertising, but public interest was not aroused The theater was only fairly filled on the opening night, but an idea may be had of the success from the fact that the theater which had, up to this time, played to average weekly receipts of about $3,000, found its "takings" increased within a single month to the unprecedented average of $7,000 a week, though the cost to the management was probably not over $100 a week for the machine itself

Inside of a year the cinematograph was installed in every vaudeville theater in America, and hundreds of new establishments came into being Thus was inaugurated the vaudeville craze which, as it progressed, brought into being many new devices, such as the Biograph and the Vitagraph In a few years, no theater was without its machine

In 1902 the "store" theater came into existence, and of these there were at one time nearly 30,000 in this country New York city had more than 600 alone An illustration of the vogue of the motion picture is best shown by the statement that one of the earliest endeavorers in this field, Marcus Loew, started in the Harlem district, about five years ago To-day this man is immensely rich. He has about forty theaters of his own, the majority of which are of the first class, such as the American, Plaza, Majestic, Yorkville, and Lincoln Square theaters, in New York Hardly a week goes by that Mr Loew does not add a theater to his list. He has now in the course of erection two magnificent amusement places, involving a cost of nearly a million dollars

About four years ago William Fox, a man yet in his early thirties, opened the first "store" theater in Brooklyn; his success was so great that within a year he had a dozen similar resorts, where moving pictures were the sole attraction. In 1907 this man bought the lease of the Dewey Theater, on East Fourteenth Street, paying a rental of $50,000 a year. He then secured the Gotham Theater, in Harlem, the Star Theater, on Lexington Avenue, and the Family Theater, on One Hundred and Twenty-fifth Street. He also has several theaters in Brooklyn Despite the enormous rentals and the low price of admission, Mr. Fox has made a fortune in the short space of four years, and last year amassed his colleagues by leasing the Academy of Music, paying a rental of $100,000 a year for a building which cost its owners but three times as much

Although Messrs Keith and Proctor have seven theaters of costly construction in Greater New York, but one of these, the Fifth Avenue, is used for the type of vaudeville for which they are supposed to stand; all the rest, including the Union Square Theater, where the cinematograph was first seen, have reverted to the camera man, and Mr Proctor has a score of theaters in the smaller cities, besides those in which he is affiliated with Mr Keith

For several years the various manufacturers of films have been sorely tried to keep up with the demands for new subjects The public patronage has grown to such an extent that millions of new theatergoers have been created To hold this patronage and prevent its being absorbed by the regular theaters, has been the aim of all concerned in this vast industry

Some of the world's greatest players have posed for the film makers, many of whom have stock companies under the direction of famous stage directors and producers.

For several years efforts have been made to create a perfect synchronism between the moving picture and the phonograph, in order that stage presentations of plays and operas could be reproduced

The spectacle has already been presented of a famous stage idol, appearing in a theater of high prices of admission, while but a stone's throw away a perfect counterfeit presentation both as to voice and action could be seen for five cents

Three of the greatest factors in the field of motion photography, including Thomas A Edison, who invented also the phonograph, have announced recently that all of the problems for an absolute synchronism were either solved, or near solution Mr Edison has prophesied that the day is near when the working man will present himself in front of a moving picture theater, deposit his dime, and witness a reproduction of scenes from grand opera, such as are presented at the Metropolitan Opera House in New York

I have already been privileged to hear and see almost an entire act of Donizetti's "Lucia de Lammermoor," including the famous sextette, as sung by Caruso, Sembrich, Plançon and others Although perfection has not yet been achieved, no great wrench of the imagination is necessary, in order to predict that another year or two at most will witness the attainment of absolute synchronism

The serious side of this situation lies in the ultimate fate of the player and singer, and by the same token of the manager and producer

We know that Caruso has earned almost as much money from the preservation of his vocal records as by grand opera. Yet, there are those who have deplored the fact that the penalty is being paid in a slight deterioration in the illustrious Italian's voice

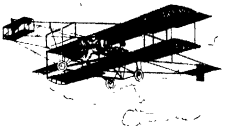
I yield to no one in my appreciation of the benefits to be derived from the phonograph, and have often wished that it had come into being in time to have preserved the voices of Malibran, Jenny Lind and Adelina Patti, in her prime

But if even one year less of Caruso is the penalty which music lovers will have to pay in order that future generations may have preserved for them his vocal records, this price is hard to yield to

It will be of interest to the reader to learn that in Paris such eminent celebrities as Mme Bernhardt Jane Hading, Mme Réjane, and Mounet-Sully have been induced to pose for the moving picture camera One French firm pays fabulous sums, in order that it may raise the level of its achievements

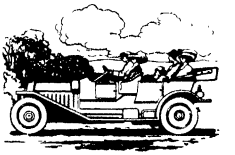
The possibilities of a perfect synchronism in effect of the two great Edison devices (for it must be understood that it was Edison who made possible the motion picture of to-day) are beyond all conception Through this great advancement, the "Passion Play," as presented at Oberammergau, could be brought to our doors, and that, too, at a not very distant date.

It is already on the cards to present before American audiences scenes from grand opera, as presented at the Grand Opera House, in Paris, Covent Garden, in London, and La Scala, in Milan. Thus grand opera novelties, which would probably not be heard in this country for



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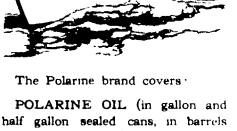
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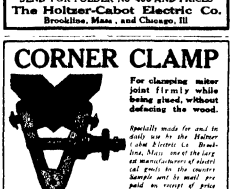
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years, will have presentations within the year of their European *premieres*; also the great Kiralfy spectacles are now being reproduced, in order that the tremendous barrier of transporting to America over 1,000 persons may be overcome.

The film companies are capitalized in the millions and there is not the slightest indication that any retrograde movement in this field will be permitted.

The great problem which presents itself is the effect that modernism may have on the actual player and singer, but after all, it is the latter element which has made possible the great progress in the moving picture industry, for they are induced to accept the liberal payments offered.

Recently $50,000 was offered to Caruso for the sole right to take his vocal records, and this sum was merely a bonus for exclusive privileges. Mme. Adelina Patti, when in this country on her last tour, *refused an offer of $100,000 for a* similar privilege, and this, too, at a period in her career when she was no longer the Patti of old.

The writer believes that the motion picture theater of the future will be conducted on a far more important basis than that of the present. Already the "store" theater is passing away, and the tendency is to secure regular theaters. In all the larger cities, large and commodious establishments are being erected and millions of dollars of invested capital are available at every turn. The effect on the regular theaters has already been appalling. Two years ago the vast chain of theaters devoted to melodrama found their position untenable, and there are to-day less than a dozen of this class of amusement temples in operation. All have reverted to what is known as "pop" vaudeville, or else they are lying dormant.

In Philadelphia there are two score of handsome theaters, newly built, some costing as high as $500,000 each, and all *created through the really tremendous ex*pansion in the field whereof I write. The attendance is enormous. It is not too much to assert that 100,000 persons attend these theaters daily in the Quaker City. In Boston the situation is quite similar, while in the smaller cities a singular state of affairs has come about. In what are called "one night stands" the moving picture has solved the problem of the local managers who have not hesitated to cast the legitimate attractions to oblivion and turned their "opery" houses into "nickelodeons" and "bijou dreams." Heretofore, the local manager would get one or two companies a week for his public's entertainment, and he had a hard time to pay his way. To-day, by the simple process of installing a moving picture machine and engaging a few minor acts of vaudeville, he is able to entertain from two to three thousand persons each day, at an average price of admission of ten cents. The expenses are small, the profits are huge. I have in mind a little town near New York, with a population of 30,000. Up to two years ago it was impossible to attract a paying audience with anything. To day the one theater available gives three performances daily. Hardly a week goes by that less than 60 per cent of the population does not enter this theater at least once, while it is an absolute normal condition to find as many as 1,000 persons waiting in the lobbies and on the sidewalks, at 9 P. M., for an exodus of the seated audience, so that they may enter and witness the second show.

The public created by this procedure is constantly being educated and gradually becomes more exacting in its demands, hence the advent of the "talking" picture, with all the enhancement which it promises to bring, should result in a general uplift, together with much benefit to the masses who must naturally appreciate any effort which will make possible for them to see and hear for ten cents that which has heretofore cost from fifty cents to two dollars.

It remains yet to be seen how nearly science and artifice have served to duplicate the original interpretation in music and drama. Mr. Edison has promised that the counterfeit will be almost perfect.

Rubber Bath Sponges

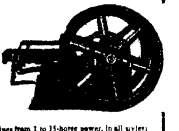
NATURAL bath sponges are becoming scarce and attempts have been made to increase the production by artificial sponge culture. The increasing price of sponges has also led to the invention of artificial sponges made of vulcanized India rubber, which have been in the market for a number of years and are already very largely used. Until recently the method of producing these substitutes, which are remarkably similar to natural sponges in structure, remained the secret of a few German firms, and the efforts of foreign manufacturers to produce rubber sponges were fruitless. It has long been possible to make porous vulcanized rubber, but the imitation of the peculiar structure of the sponge and the production of pores and cavities of various sizes in communication with each other appeared impossible. This object is accomplished in the manufacture of rubber sponges, which is now carried on in other countries than Germany, in the following manner, according to an article in *Caoutchouc et Gutta-percha*. In the preparation of the rubber, certain volatile constituents are added which, in the process of vulcanization inflate the rubber producing an effect similar to that of yeast in bread. Usually a mixture of alcohol and amyl acetate is employed for this purpose. In order to prevent premature evaporation of these very volatile liquids, the rubber is first incorporated with the usual additions, sulphur chalk, etc., and rolled out cold into thin sheets. These sheets are dipped in the mixture of alcohol and amyl acetate and passed again through the rollers. These operations of dipping and rolling are repeated ten or twelve times. The mass is then divided into pieces the size of the fist, which are saturated with a solution of Para rubber and wrapped tightly in silk paper. In this condition the pieces are placed in the vulcanizer, in which the pressure of the steam is allowed to rise to about one half atmosphere in fifteen minutes, is held at this point for twenty minutes, then increased to two and one-half atmospheres and after twenty minutes more is allowed to sink to the pressure of the external air. The sponges are then taken from the vulcanizer allowed to cool in the air, and washed and brushed in water in order to remove the silk paper. They are finally boiled in a two per cent solution of soda and cut up into pieces of the desired form and size. These rubber sponges cannot compete with the finer grades of natural sponges, but they form very good substitutes for the medium and coarser grades.

Summary of the Reclamation Projects

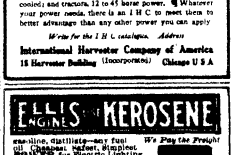
(Continued from page 138.)

been built, so that now, on many streams, no water escapes whatever, and the lower reaches of the river bed have been grown over with trees and vegetation. The reclamation work in this district is scattered over the States of Colorado, Kansas, Nebraska, South Dakota, Oklahoma, and southern Wyoming. In the valleys the rainfall varies from 6 to 16 inches, in the mountains above the project, it reaches as high as 30 and 40 inches. The value of the irrigated lands ranges from $75 to $100 per acre in the northerly projects, to $100 to $1,000 in the southern projects, much of this land having sold for $3 to $10 per acre before the projects were inaugurated. UNCOMPAHGRE PROJECT, COLORADO.—In the Uncompahgre Valley is a body of fine land of 150,000 acres, but the run-off of the Uncompahgre River is limited, and after settlement a succession of crop failures followed. It was found that the run-off of the Gunnison River in the adjoining valley was very large, hence arose the suggestion to tunnel the intervening mountain, and divert the Gunnison River into the Uncompahgre Valley. An attempt was made to do this, but the cost was too great. The Reclamation Service took hold of the work, and completed the tunnel, six miles in length, which has been in use now during the past two seasons. One hundred and forty thousand acres in the Uncompahgre Valley have now an assured water supply, which is to be augmented by building a reservoir on Taylor River, a tributary of the Gunnison. GRAND VALLEY PROJECT, COLORADO.—This project in Mesa County, western Colorado, is designed to irrigate the higher Mesa lands, which include the

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best and most fertile country. The Reclamation Service has planned a canal which will furnish water to 60,000 acres of irrigable land from the flow of the Grand River. NORTH PLATTE PROJECT, WYOMING AND NEBRASKA—One of the chief water courses in the Middle West is the North Platte River, heading in the high mountains of Colorado and flowing through Wyoming and Nebraska on its way to the Missouri. Although its flow is large during the spring months, it goes practically dry during the later summer months, and is generally limited in flow after July 1st. To conserve these waters, a large dam 218 feet in height has been built to form the Pathfinder Reservoir, which has a capacity of over a million acre-feet, and will irrigate some 350,000 acres in Wyoming and Nebraska. The first unit, comprising 117,000 acres, is nearing completion, the second, comprising 80,000 acres, will shortly be started, and the third is now under investigation. BELLE FOURCHE PROJECT, SOUTH DAKOTA.—Surrounding the Black Hills in South Dakota are situated numerous bodies of land of more or less limited areas, which would be fine farming land if there was sufficient moisture; but as the rainfall is below what is needed to produce crops, these areas are practically unoccupied and of very little value. The Belle Fourche Project, nearing completion, stores the water of the Belle Fourche River in a reservoir which will have a capacity of 200,000 acre-feet of water, and will conserve about 100,000 acres of irrigable land. The water is diverted into the reservoir from the river by a canal 70 feet wide and 10 feet deep. From the reservoir two large main canals carry the water to the land, from which lateral canals distribute it to the farms.

Brooks Comet of 1911

THIS comet, discovered by Dr William R Brooks at Smith Observatory, Geneva, N Y., on July 20th, has been observed on every clear night by its discoverer, and at many other observatories throughout the world. On August 9th it was about seven degrees north of the star Beta in the constellation Pegasus, from which point the comet is moving northward about one degree daily.

Three of Prof Brooks's previous comets have been found in Pegasus—he has discovered twenty-six comets in all—so that this constellation seems to be a favorite hunting ground for the Geneva astronomer. The following elements of this comet have been computed by Mr Young and Miss Aitken at the Lick Observatory:

PERIHELION PASSAGE, OCTOBER 27TH, 1911

	Deg	Min
Perihelion minus node	153	25
Longitude of node	282	53
Inclination of orbit	33	45
Perihelion distance	0 482	

The comet is coming nearer and growing brighter, and promises to be an interesting object. It is now visible in a moderate-sized telescope, and will be observable for several months.

Motor Omnibuses in War

THE German military maneuvers this year will, as usual, possess many interesting features affecting modern warfare. It is anticipated that motor omnibuses will play a very great part in the maneuvers.

Each motor omnibus will be provided with room for fifty soldiers and possess a speed of about twenty-six kilometers an hour. This experiment was tried with a small portion of troops last year in Germany, and was found to work splendidly, the men being conveyed to the desired positions far quicker than if they had marched on foot, in addition to reaching their destination much fresher and readier for the work before them.

This year, when a long march is occurring, it is intended to use the motor omnibuses in conjunction with foot marches. The buses will convey a portion of the troops ahead, drop them at a certain point, whence they will continue their march, refreshed with the rest and the drive, and the buses will return to the main body for another load of soldiers, who will, in turn, be conveyed to the new advanced guard.

Costly Mining

IT might be said that in these days gold mining is about as expensive a way of making money as one could devise.

It is often necessary to put a fortune into the ground before one can begin to take out a bit of the gold. This is especially true of hydraulic mining. The largest hydraulic gold mine in the world is that in Trinity, California. There the owners are engaged in tearing away great sections of Oregon Mountain with immense streams of water. Now, to dislodge hundreds of tons of earth, and to roll immense boulders about as if they were marbles, requires, it is needless to add, a great force.

The operations at the Trinity mine extend over an area of between 2,000 and 3,000 acres. It was demonstrated from the first that gold was present in paying quantities in this mountain, but the difficulties in the way of getting at it were very great. There was no water available in the vicinity of the proposed mine, and water—a lot of it—was necessary. So it had to be brought through a pipe line from a point thirty miles away. A part of this line goes through a tunnel in the side of a mountain. This tunnel is a mile and a half long and its construction consumed a period of two years. The water is forced into a huge reservoir on the top of Oregon Mountain, and is conducted from this to the nozzles of the hydraulics.

From one of these nozzles a stream eight inches in diameter rushes out. The dislodged earth is carried through races and sluices prepared to receive it. Nearly 10,000 cubic yards of earth are turned into these sluices every day. Once a month the sluices are drained of the water, and the gold is gathered. Its weight carries it to the bottom of the heap. The gold obtained at these monthly intervals ranges from $15,000 to $40,000 in value.

As the mine is about fifty miles from a railroad, one can easily understand how great is the expense of transporting machinery and supplies. The cost of the tunnel and pipe line, too, was large, so that, before a dollar's worth of ore was taken from the mine, quite a fortune had been put into it. The present system is not much like that of the early days in California, when one or two men started out to seek a fortune armed with nothing but picks, shovels and pans. The returns on mining investments in these days, although in some cases good, are no greater than in many manufacturing concerns.

Spiders' Threads in Astronomy

THE cultivation for scientific uses of certain species of spiders, solely for the fine threads they weave, has an important bearing upon astronomy.

No substitute for the spider's thread has yet been found for bisecting the screw of the micrometer used for determining the positions and motions of the stars. Not only because of the remarkable fineness of the threads are they valuable but because of their durable qualities.

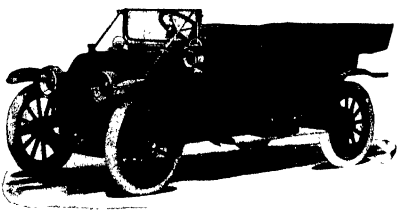
The threads of certain spiders raised for astronomical purposes withstand changes in temperature, so that often in measuring sun spots they are uninjured when the heat is so great that the lenses of the micrometer eyepieces are cracked.

These spider lines are only one-fifth to one-seventh of a thousandth of an inch in diameter, compared with which the threads of the silkworm are large and clumsy.

Turbine Water Meters

IN the *Revue de Mecanique*, Mr. Dariès publishes a detailed monograph on turbine water meters, or so-called speed meters, these are somewhat less sensitive, but, on the other hand, cheaper than those of disk construction.

The turbine water meter consists essentially of a vertical shaft provided with blades, and contained in a chamber into which the water is admitted through oblique orifices. The momentum of the water sets the shaft rotating, and a system of toothed wheels connected to an indicator registers the number of turns



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Notes and Queries

Kindly keep your queries on separate sheets of paper when corresponding about such matters as patents, subscriptions, books, etc. This will greatly facilitate answering your questions, as in many cases they have to be referred to experts. The full name and address should be given on every sheet. No attention will be paid to unsigned queries. Full hints to correspondents are printed from time to time and will be mailed on request.

(12511) W T H writes: In your Answers to Correspondents, No. 12470, it is stated that steel is compressible at the rate of 68 millionths per atmosphere of pressure. I have the apparatus to make a simple test of the matter, a cylindrical tank, of sheet tin, 12½ inches in diameter with cone-shaped ends, having a capacity of about three cubic feet. The "tin" does not exceed 1/64 inch in thickness. My proposition was to pump 15 pounds per square inch air pressure into the tank and observe the increase in the girth when the pressure was on. I figured that if steel (or iron) was compressible (or extensible) at the rate mentioned, the girth of the tank should be 3/8 of an inch greater when the pressure was on. I made the experiment three times. The first time there was apparently an elongation of about 1-16 inch. The second and third times I used more care, keeping the tape measure in the same position and keeping it close to the same tightness in all the measurements. In the two last trials there was no observable difference in the girth before and after the pressure was on. Of course extensibility is not compressibility, but I assume that they are about the same in amount, only in opposite directions. The experiment seems to indicate that there is no appreciable extension of iron with a tensile strain of nearly 7,000 pounds per square inch. Are my figures right or 68 millionths in volume per atmosphere of pressure tells nothing of the deflection in one direction only under a strain. The coefficient of elasticity of steel is 30,000,000, which means that one pound per square inch tensile stress will elongate the steel 1/30,000,000 of its length. Using the formula $pd \div 2\ 7S$ for your experiment $15 \times 12½ \div 2 \times 1/64 \times 6$ and $S = 6,000$ pounds per square inch on the cross-section of the trimmed iron, 1/64 inch thick. This would elongate the circumference of the tank $6.000 \div 30,000,000$ or $1 \div 5,000$ of its $12½ \times 3.14$ length around, equal to $\frac{37.5}{5,000}$ or 0.00785 inch—too small to measure. Evidently the seam of the tank yielded in the first experiment, and after the butt-motion was taken up you obtained no appreciable effect from the 15 pounds pressure again applied.

(12512) S E K says: 1. Is there such a thing as "heat" lightning, or is all lightning "chain" lightning, and what we call heat lightning simply the reflection of a distant thunder storm on the clouds? A. The lightning called "heat lightning" is usually due to the reflection of a lightning flash below the horizon upon clouds above the horizon. It is too distant for one to hear the thunder from the flash. All lightning is not "chain" lightning. The real existence of "ball" lightning is now quite generally admitted by men of science. 2. When we see oblique rays apparently coming from the sun, is this really the action of the sun "drawing water," as the saying is? A. The appearance which is called "the sun drawing water" is caused by the sun's light passing through openings in the clouds and illuminating the particles in the air below, thus producing light streaks in the space below. The same may be seen sometimes after the sun has set, the stripes there being directed upward.

(12513) A W K asks: Will you kindly inform me through your Question Column of a good formula for wet cells? A. There are four principal forms of wet cells, the one to be used depends upon the character of the service required. For interrupted, occasional work such as bells, burglar alarms, and igniting gas and gasoline engines, the Leclanche cell is the best. Its solution is made by dissolving a quarter of a pound of ammonium chloride in water, enough for one cell. The Edison cell is also used for ignition and similar purposes. Its solution is a rather strong solution of caustic potash. The proper quantity is furnished with the cell. For a steady, constant current, such as is required for electroplating charging small storage cells, or for a telegraph battery, the gravity cell is the best. Its solution is a saturated solution of copper sulphate in the copper plate in the bottom of the jar with crystals of the same salt in excess to maintain saturation. And last for giving a large current for a short time, such as for heating a wire coil, running a motor or working an induction coil for X rays or a small wireless telegraph outfit, the best cell is the bichromate cell. The solution is a strong solution of bichromate of potash in sulphuric acid and water. The mode of preparing the solution as well as of making the battery is well described in SUPPLEMENT No. 702. A full description of all these cells is contained in SUPPLEMENT Nos. 157, 158, 159, which you should have if you need to use wet cells for any purpose. We will send the four papers for forty cents. Wet cells are not much used. The more convenient dry cell has taken their place. The dry cell is simply a Leclanche cell in which the solution is absorbed in some material so that it will not run out. The cell is then sealed to prevent evaporation.

(12514) E F B says: Can you tell me approximately how many vibrations per second are required to produce a sound so high in pitch that it would be imperceptible to the average human ear? A. The average range of hearing is from 16 to about 40,000 vibrations per second. Some persons are not able to connect 16 vibrations per second into a continuous tone, and for some the inability to hear is below 40,000. This matter is tested by a Galton's whistle, which can be tuned up to more than 40,000 vibrations.

(12515) J D asks: A filled a drinking glass full of water, placed a piece of paper over the top, held it firmly, reversed the glass paper side down, then removed his hand from the paper, the paper remained in its place, and the water did not run out of the glass. A says it is due to the atmospheric pressure on the outside. B says it is vacuum and atmospheric pressure. Which is correct? A. The experiment you describe is explained by the surface tension of the water, which prevents the air from entering between the paper and the upper edge of the glass, and the atmospheric pressure, which holds the paper up and prevents it from dropping off the glass. It is not necessary to have the glass full of water if only partly full, with air above the water, the experiment succeeds just as well. No vacuum is formed.

(12516) F D D asks: The Nautical Almanac states that June 21st (astro day) is the longest day of the year, being 15 hours 23 minutes 0'60 W longitude, 43 N latitude), but the earth does not reach aphelion until July 2nd on which date the day is 5 minutes shorter than June 21st. I have always supposed that the axis of the earth tipped toward the sun to its greatest degree on June 21st, and consequently the earth must be at aphelion on that date. A. The sun is longest above the horizon on June 21st or 22nd and hence this is the date of the longest daytime, or, as we term it in common speech, "the longest day." This is because the sun is then farthest north. It is vertically over the Tropic of Cancer, and makes the longest daytime in the northern hemisphere and the shortest daytime in the southern hemisphere. There are more degrees of the diurnal are above our horizon in June than in January or any other month of the year in the northern hemisphere. This does not depend upon perihelion at all. The earth is in perihelion on January 1st to all parts of the earth alike, and in aphelion early in July. At perihelion the earth is traveling swiftest in its orbit, and at aphelion it is moving slowest. At perihelion the sun therefore makes more right ascension between noon and noon than at any other time of the year. For this reason the time from noon to noon is longest, more seconds, on January 1st. This you can easily verify by the Nautical Almanac. January 1st is the longest day, from noon to noon, in the year. From this you will see that the longest day is a very different idea from the longest daytime. The longest day nearly coincides with the shortest daytime in the northern hemisphere but in the southern hemisphere the longest day and longest daytime are nearly coincident. The two are determined by different conditions, and are not dependent upon each other at all. The axis of the earth is for limited periods in positions parallel to itself. At the equinoxes, March and September, the sun is vertical over the equator, and the axis of the earth makes a right angle with the line joining the centers of the earth and the sun. At the summer solstice of the northern hemisphere in June, the earth's axis has come around apparently, so that its northern end is directed 23 degrees 30 minutes over toward the sun. The converse of this is true of the southern hemisphere at the same time. At the winter solstice of the northern hemisphere the axis of the earth has shifted 47 degrees from its position as referred to the sun from what it occupied at the summer solstice. A small globe, even an orange, and a lamp will enable you to demonstrate all this experimentally. It is nicely described in Todd's "New Astronomy," pages 150 to 160, a book which we send for $1.50 postpaid. Our circulation takes the Scientific American all over the world, and a description of these phenomena written for the northern hemisphere would be the reverse of true for the southern hemisphere.

(12517) R J G asks: Does an exhaust fan create a vacuum when running at full speed? A. An exhaust fan creates a partial vacuum only. It cannot draw all the air out of a room or space. The very best mechanical air pump cannot do that.

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NEW BOOKS, ETC.

HOME VEGETABLE GARDENING. By F. F. Rockwell. Philadelphia: The John C. Winston Company, 1911. 16mo.; 262 pp.; illustrated. Price, $1 net.

Instead of treating his subject in the usual encyclopedic manner, the author, himself a practical gardener, has endeavored to tell the man with a suburban lot how to put in a successful vegetable garden, and the things which such a man would wish to know are told in some kind of natural sequence, that the knowledge may be acquired and utilized to the greatest advantage. The area necessary for families of various sizes is given, the best way to apportion the space to the vegetables grown, and the varieties most easily and profitably raised, with the most approved methods of planting, cultivating, spraying, and fertilizing. Fruits and berries are given considerable space, and a strong argument made for the growing of them. Sixty four pages of illustrations brighten and improve the work. We note that the only index is by chapter headings. A detailed index would have been an appreciated and useful feature.

HAND BOOK OF GASOLINE AUTOMOBILES. New York: Association of Licensed Automobile Manufacturers.

This catalogue illustrates in the best possible style upon fine coated paper the machines made by those firms which make up the Association of Licensed Automobile Manufacturers. Touring cars, roadsters, runabouts, trucks, power wagons, every conceivable type of gas-propelled vehicle is here pictured with its specifications appended. This is the eighth annual announcement of the Association of Licensed Automobile Manufacturers, which now comprises seventy-nine makers and five importers.

THE ELEMENTS OF MACHINE WORK. By Robert H. Smith. Boston: Industrial Education Book Company, 1910. 8vo; 192 pp., 204 illustrations. Price, $2.

In the matter of text books our students of mathematics, physics and chemistry are better provided for than are our students in technical and trade schools and our shop apprentices. "The Elements of Machine Work" takes the learner through the processes of laying out work, chipping, filing, and scraping, hardening, tempering, and testing of steels, pipe fitting, soldering, and brazing, aligning shafting and installing machines. The matter is condensed but none the less careful and eminently practical. Not technical students alone, but every youth who runs a lathe or uses tools as a hobby, may benefit by adding this text book to his working library.

THE GYROSCOPE. By V. E. Johnson, M.A. New York: Spon & Chamberlain, 1911. 12mo.; 52 pp. Price, 60 cents.

This is a brochure setting forth the principles and behavior of gyroscopic toys, from the spinning top to the monorail car. It abounds in instructive experiments, gives plans for the construction of a model car with various methods of drive and a special form of contact planes, and has a final word to say in behalf of other stabilizing systems and their probable utility in combination with the gyroscopic method.

QUESTIONS AND ANSWERS FOR AUTOMOBILE STUDENTS AND MECHANICS. By Thomas H. Russell, A.M., M.E. Chicago: The Charles C. Thompson Company, 1911. 8vo.; 140 pp.

The questions progress in logical order from basic principles and the main features of construction and operation to accessories, details, and varying methods. The catechism differs somewhat from most guides of similar form, in that the answer does not immediately follow the query. Instead, there is a chapter of numbered questions followed by a chapter of correspondingly numbered answers. This facilitates the use of the questions as a review test, yet places the answers within easy access in case of need. A drawback of the catechism is its entire lack of illustration. This somewhat quits it for the use of the absolute novice unless supplementary words and diagrams are at hand. It is particularly designed, however, for school teaching, for the machine shop, or before the board of examining engineers. For any of those purposes it is well conceived and covers the field in a commendable manner.

MECHANICS FOR ENGINEERS. A Text-Book of Intermediate Standard. By Arthur Morley, M.Sc. New York: Longmans, Green & Co., 1910. 8vo.; 280 pp.; illustrated. Price, $1.20.

As a text-book, this is meant to fill a need brought about by the fact that the requirements of students in engineering are not identical with those of the student in general science. Since engineering students constitute a large proportion of the enrollment for mechanics classes in technical schools it is only right that they be provided with a course which recognizes their special needs. The author adheres to the gravitational system of units, defending it on practical grounds and pointing out that with proper premises it is just as rational as the "poundal" system which is confined to school work and must be discarded upon taking up practical problems in engineering. It is assumed that the reader is familiar with algebra to the progressions, the elements of trigonometry, and curve plotting. The calculus has not been used. The course laid down should easily be completed in a year.

INTRODUCTION TO GENERAL CHEMISTRY. By John Tappan Stoddard, Ph.D., New York: The Macmillan Company, 1910. 8vo.; 432 pp. Price, $1.60 net.

The information here given is graded and arranged with a view to its use as a first-year course in chemistry. The importance of sound reasoning from experimental results is recognized, and much of the work given is of a nature to induce in the student the true scientific attitude combined with enthusiasm and judgment. There are no pictorial illustrations, the writer arguing that the class room or laboratory furnishes sufficient concrete examples in apparatus, while confusion is apt to arise when the drawings of a text-book differ in general form or in detail from the actual experimental apparatus used.

GOOD ENGINEERING LITERATURE. What to Read and How to Write. With Suggestive Information on Allied Topics. By Harwood Frost. Chicago: Chicago Book Company, 1911. 8vo., 422 pp.

Assuming that every engineer is sooner or later called upon to do some form of literary work, Mr. Frost essays to instruct the engineering fraternity in the art of written expression—in the preparation of reports, specifications and contracts, and of descriptive papers for technical societies and periodicals. A few rules in grammar and orthography are given, but the instruction is mainly confined to imparting such knowledge as will result in the clear and forcible description of works and ideas. The author is not only a successful maker of books himself, but was formerly editor of *The Engineering Digest*, and the work is full of the most condensed and valuable information which readers and writers of technical subjects would be benefited in learning. There are chapters on collecting and arranging material on exercising the memory, on the preparation of manuscripts, the "field" and "policy" of technical journals, and "the making of a book."

POLAR EXPLORATION. By William S. Bruce, LL.D., F.R.S.E. New York: Henry Holt & Co., 1911. 12mo.; 256 pp. Price, 75 cents net.

There is a peculiar fascination about polar adventure that seems to be in inverse ratio to its rigors and loneliness. Dr. Bruce, with nine expeditions to his credit, recounts in simple, forcible English the facts of which keen and extended observation has made him master. He begins by stating astronomical facts that the reader should know, that the polar days and nights are each of six months duration, that it is always noon at the pole, whether light or dark, although there are alternations of seasons, that the sun describes an ascending spiral during one season, and a descending spiral at another. Having seen that the reader forms a right conception of these conditions, the author proceeds with description and comment until he has packed between the covers of his little book pictures of Arctic sea and ice, observations on coloration, and on plant and animal life, and thrilling incidents on ship and foot. As the volume is in adventure, its chief claim to attention is in showing the aims of polar exploration in its relation to science and biology. A work of greater length and importance is promised.

THE EVOLUTION OF PLANTS. By Dunkinfield Henry Scott, M.A., LL.D., F.R.S. New York: Henry Holt & Co., 1911. 12mo., 256 pp.; illustrated. Price, 75 cents net.

"The Evolution of Plants" is an attempt to tell "the story of the development of flowering plants, from the earliest geological times, hitherto locked from technical language." Dr. Scott restates in brief the Darwinian theory, afterward dealing at considerable length with the problem and the evidence. There are chapters on the evolution of the seed plants, of the ferns, and of the higher spore plants. The story concludes with deductions drawn from the fossil record as compared with the organisms of existing plants, from the likeness between fern and seaweed, from the consistency between the thallus-theory and the fossil record, and with theories of a more general kind based upon the known facts. A few errors which have escaped the attention of the proofreader do not materially affect the popular value of the book.

SECOND COURSE IN ALGEBRA. By Herbert E. Hawkes, Ph.D., William A. Luby, A.B., and Frank C. Touton, Ph.B. New York: Ginn & Co., 1911. 12mo.; 264 pp.; illustrated. Price, 75 cents.

The course as laid out includes all the topics necessary for entrance to college, and is particularly adapted to students whose second year in mathematics has been devoted to geometry. The first part of the course is a very thorough review, leading up to the advanced material in which the best methods, new or old, are employed. Graphs are utilized in an ingenious manner in connection with logarithms, and all the exercises and problems aim to present new and varied material in an appealing way.

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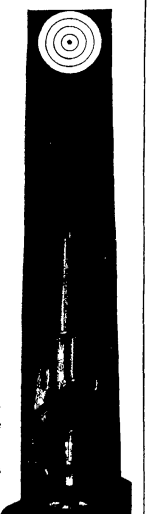
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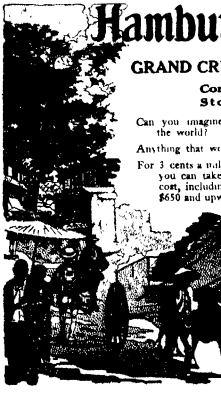
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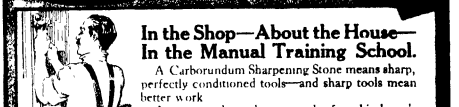
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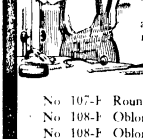
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Science

Return of Wolf's Comet.—We read in *Cosmos* that Prof. Max Wolf himself has re-located, on the 19th of June, the comet which is known by his name. Its position on that date at 12 h. 4 m. 9 s. (mean Koenigstuhl time) was R. A. 18 h. 46 m. 16 s. Dec. 13 deg. 23 m. N. The brightness was equal to that of a star of the fifteenth magnitude, so that the comet was just visible in large instruments This periodical comet takes 6.823 years to complete its orbit It passed its perihellon on May 4th, 1905, so that it is due to return there in the early months of 1912; its distance from the sun will then be 1.095 (refer to the earth's distance from the sun as unity); its aphelion the comet recedes to a distance of 5.689.

The Ivory Supply.—In view of the rapid disappearance of the herds of elephants which formerly roamed in Africa, and the limited number of those animals remaining in Asia, attention has been called to the enormous supply of ivory which exists in the frozen tundras of Siberia, and which, it is thought, will probably suffice for the world's consumption for many years to come. This ivory consists of the tusks of the extinct species of elephant called mammoths. The tusks of these animals were of great size, and are wonderfully abundant at some places in Siberia, where the frost has perfectly preserved them, and in many cases has preserved the flesh of the animals also

The Intrinsic Light of the Stars.—According to *L'Astronomie*, M. Nordmann, of the Observatory of Paris, has made some interesting calculations of the intrinsic light of a number of stars, based on the results he had previously attained in regard to their effective temperatures The brightness of a star, as seen from the earth, does not depend wholly upon its size and distance Thus M Nordmann finds that Sirius and Vega emit *light* the brightness of which is six million candle-power per square centimeter, while at the other end of the scale the light of Aldebaran amounts to only 22,000 candle-power per square centimeter The intrinsic brightness of Vega is, according to this calculation, nineteen times that of the sun If Vega were of the same size as Aldebaran and at the same distance from the earth, the former would appear to us over two hundred times as bright as the latter

Queen Ants and Queen Bees.—It is claimed that the queen ant has not had justice done her by naturalists. As compared with the famous queen bee, she is regarded by Doctor William Morton Wheeler as a far more admirable creature In fact, they are, in many important respects, diametrical opposites. The queen bee is, it is pointed out, a degenerate creature, unable to nourish either herself or her young, to visit flowers, to build combs, or to store them with honey. With the queen ant quite the reverse is true. She is held to be a perfect exemplar and embodiment of her species, and the worker ants suffer from incomplete and retarded development The queen ant is a very industrious and intelligent worker, and, in the opinion of the authority mentioned, she forms an exceedingly interesting subject for study, and has not hitherto been well understood.

The Australian Antarctic Expedition.—Dr. Douglas Mawson, of the University of Adelaide, recently addressed the Royal Geographical Society, in London, outlining the plans of the expedition which will leave Australia under his command about the end of this year. The object is to explore the long stretch of coast known as Wilkes Land, lying between Cape Adare and Gaussberg (Kaiser Wilhelm II Land). Several parties will be landed at various points. The expedition is being recruited chiefly from graduates of the universities of Australia and New Zealand, and every member of the land parties will be a specialist in some branch of science A visit to the south magnetic pole is part of the programme. From a geographical point of view this undertaking appears likely to yield the most interesting results of any of the Antarctic expeditions now projected or in the field.

Electricity

Electric Contact Device for Measuring Volumes.—Prof. Theodore Richards, says *Knowledge*, has employed a method of electrical contacts for measuring volumes very accurately. As the mercury is lowered so it can be set to just make or break an electrical contact consisting of a fine platinum point. He has used the method to determine differences in the compressibilities of liquids.

Sound Waves Produced by the Oscillatory Discharge.—The oscillating spark discharge produces sound waves which are not directly recognisable by the ear, owing to their high frequency Their presence has, however, been demonstrated by Messrs Campbell and Dye, as described in the *Electrician* by a modification of the well-known Kundt's dust tube, A glass tube closed at one end is placed in front of the spark gap, in such manner that the sound waves are reflected at the bottom of the tube, forming loops and nodes. In order to ascertain the position of these loops and nodes, a small amount of lycopodium powder is sprinkled in the tube, when it collects in small heaps at the nodes In this way the experimenters ascertained the existence of sound vibrations of a frequency lying between 140,000 and 800,000 periods per second.

A Wireless Automobile.—A number of cadets from a military academy of the Northwest is now making a tour of about three thousand miles through the East and back to Chicago in four automobiles, whose engines drive the generators for the electricity of the wireless apparatus with which each machine is equipped and the machines are operated about thirty or forty miles apart, communication being maintained by means of the wireless Each machine is provided with an extension mast, while balloons, also forming part of the equipment of each machine, can be utilised for carrying the antenna wires to any desired height The expedition anticipates visiting Washington, Annapolis, New York, West Point and other points of interest throughout the East.

Calibrating Tubes by Electric Resistance Measurement.—The measurement of resistance of a mercury column has been employed by T R. Merton to calibrate capillary tubes, always a troublesome proceeding when done by measuring the change in length of a pellet of mercury. The English periodical *Knowledge* describes Mr. Merton's method as follows: The ends of the capillary tube communicate with two mercury cups which are connected to one arm of a Wheatstone's bridge. The mean radius r is given by $r^4 = \frac{1+2dr}{\kappa s f}$ where l is the length of the capillary, f the found resistance and d a correction for the stream lines at the ends of the capillary, κ the specific conductivity of mercury It has occurred to the writer that measurements of volume in gas burettes might be made by inserting an iron resistance wire down the burette inside so that the mercury uncovers more or less of the wire as it is raised or lowered, the change in resistance of the wire being accurately measured.

Handling Iron Ore with Electric Magnets.—The *Electrical World* states that at Moose Mountain Mine in Ontario, Canada, high-grade magnetic iron ore is picked from the ground and loaded into cars by electro-magnets. The ferrous material found on the side of a hill is loosened and broken down by blasting, and rolls to the foot of the hill, where an electro-magnet, mounted on a crane, picks it up and loads it into mine cars, at the same time making a rough separation, since rock and non-magnetic material are left behind. The electro-magnet can handle 1,200 pounds of pig-iron at a load, but the magnetic quality of the unrefined ore is such that 800 pounds can be picked up easily. This is the average of a number of loads the individual lift sometimes being several hundred pounds greater. A steam shovel was formerly used for loading the ore, but the density and hardness of the magnetic destroyed the buckets rapidly. The electro-magnets also save handling a quantity of stone, and thus relieve the crushing and magnetic separating plant, where the material is concentrated before being shipped.

SIXTY-SEVENTH YEAR

SCIENTIFIC AMERICAN

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HEIGHT OF OCEAN WAVES AT VARIOUS WINDS COMPARED WITH FREEBOARD OF THE "MAURETANIA."—[See page 16.]

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The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are sharp, the articles short, and the facts authentic, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

The purpose of this journal is to record accurately and in simple terms, the world's progress in scientific knowledge and industrial achievement. It seeks to present this information in a form so readable and readily understood, as to set forth and emphasize the inherent charm and fascination of science.

The New Aerotechnical Institute in Paris

ONE of the most notable events of the year, both to aeronauts and to the scientific world in general, is the establishment of the great laboratory to be known as "L'Institut Aerotechnique de l'Universite de Paris."

The donor is M. Henri Deutsch de la Meurthe, long known as a munificent patron of those daring spirits who are seeking the conquest of the air. The opening exercises took place on the sixth of July before a distinguished assemblage, the inaugural address being delivered by Prof. Appell, member of the Academy and Dean of the Faculty of Sciences.

The institute consists of an immense laboratory for the study of practical problems in aeronautics by the aid of the most advanced science and with an equipment as perfect as possible. An important feature is a track 4,593 feet long, on which specially constructed cars run, giving opportunity for the study of the operation of planes, propellers, and other parts of the machines when moving through the air at high speed.

There are associated laboratories of Physics, Chemistry, and Mechanics for the investigation of the materials used, with reference to such questions as their purity, durability, elasticity, strength, and resistance.

The services rendered by this remarkable institution will be twofold. In the first place there will be a permanent staff of investigators making methodical researches in the endeavor to ascertain the fundamental data necessary to aeronautical achievement. Secondly, the establishment will be open to inventors and builders of aircraft who wish to test their apparatus, and to makers desirous of trying out new ideas. Furthermore, all its resources will be put expressly at the disposition of officers and engineers designated by the respective Ministers of War of the Marine, and of Public Works.

The plans have been conceived and executed by the well-known engineer, M. Hugon. Details of management, programs of experiment, and methods of research have been elaborated by a council composed of the founder, of officers and engineers representing the ministers concerned, of builders and practical airmen, and of competent scientists and members of the faculty, such as the professor of Experimental Mechanics and the nominee to the Chair of Aviation founded by M. Basil Zaharoff.

In a brief *resume* of the chief problems to be attacked, Prof. Appell pointed out that the motor was the very heart of all aircraft, whether dirigibles or aeroplanes, and in the case of the latter the slightest defect in this essential organ, such as imperfect action of the carburetor, or ignition or lubrication system, might precipitate a catastrophe. Hence there is special provision of a thorough equipment in the institute for the determination of the essential facts regarding motors, such as consumption of fuel, horse-power, revolutions per minute, etc.

Of almost equal importance are the propellers. Hence endeavors will be made to ascertain the characteristics upon which the propulsive power and efficiency of propellers depend, besides determining whether their action is the same when revolving in an artificial current of air as when driving a machine through the atmosphere.

"But the most important and as yet the most obscure subject of all," remarks Prof. Appell, "is Aero-dynamics itself. What are the laws of the resistance of the air? Can they be exactly determined by placing a plane in an artificial current of air as in the admirable experiments recently conducted by M. Eiffel? Or must we admit that the phenomena affecting the back of the plane differ according to whether it is placed in a current of air from a blower or whether it is driven forward in free air like the wing of an aeroplane? An experimental thesis recently presented to the faculty by the Duc de Guiche tends to confirm such a difference."

It will be an object of the institute to carefully compare such experiments as these, and the car running on a track is expected to be particularly useful in this connection. Besides a car for testing propellers there will be a second one electrically propelled, which will be used for testing full-sized aeroplanes, at a possible speed of 110 kilometers (68.3 miles) per hour. Registering apparatus will permit the measurement of the various pressures it is desirable to determine.

For experiments with smaller surfaces a special circular building, the largest ever constructed for this purpose, will be used.

These cars will be very useful to inventors who wish to test their devices. By placing the machine, or a reduced model of it, on the car, it may be seen at once whether practice confirms theory.

In the same way may be estimated without danger to the pilot the influence of the shape of the wings, of their angle of attack, of the inclination of the rudders, as well as the value of various passive resistances.

All these results will serve, as Prof. Appell points out, for the establishment of fundamental formulæ. "The general equations of the movement of the aeroplane have been given," he observes, "authoritatively by our colleague, M. Painleve (in his treatise, *On the Dynamics of the Aeroplane*), but they still contain many unknown coefficients.

"The determination of these coefficients must be made by careful experimentation. The experience of actual flight is too complex, as all the elements of the machine are operating at the same time, and it is hence impossible to study separately the effect of each of them. The method of the car, on the contrary, permits the analytic study of the individual role of each part, and the founding of the technique of the aeroplane upon a solid scientific basis."

One of the chief aims of this new research laboratory is the solving of the problem of automatic stability, which is the principal problem still remaining for the aeronautical engineer to clear up. The long track in the open air will make possible the testing of all sorts of stabilizing devices under actual conditions of flight, while similar tests on models can be made on the track within the circular building. A power plant of 200 horse-power furnishes ample electricity to drive the testing cars at high speeds.

The whole concept and execution of this great enterprise breathe a generosity and public-spirited endeavor creditable alike to the founder and to the savants associated with him. It cannot fail to be productive of results of great and permanent value in the new art of air traffic.

A New Relic of the Parthenon Gables

THE extant sculptures of the Parthenon, which the current opinion erroneously attributes to the great Pheidias, are distributed in four principal groups. Several fine horse heads of the east gable and two coupled human figures of the west gable remain *in situ* on the front and back cornices of the famous temple. The building retains, also, the twenty-eight mutilated metopes of its exterior, Doric friezes at front and back, and the sixteen very slightly injured relief slabs of its low relief Ionic frieze at the west end of the temple, where the procession of Athenian horsemen is still forming. Lord Elgin's Italian agent Lusieri spared some additional blocks of both friezes on the long north and south sides of the ruin, when he threw its cornices down to free and extract the sections which he conveyed to London through the vicissitudes of the Napoleonic blockades. It will be remembered that Lord Elgin himself was held prisoner in France for a season. But only one of his consignments of Athenian marbles was captured by a French frigate. The Scotch earl's generous rival, the Marquis de Choiseul, purchased and returned this to its British owner without charge. Part of the broken but superb torso of Poseidon, another torso supposed to be Prometheus, and the semi-figure of the moon goddess Selene driving her steeds into the brine are among the Parthenon marbles preserved in the Akropolis Museum. Another is the splendid frieze block with the sacrificial cows, which Count de Laborde excavated at the foot of the temple in 1840. A more recent excavation at Athens resulted in the recovery of the head of Hebe from the east frieze. Athens has never yet forgiven Lord Elgin's capture of the major part of its Periklean inheritance in carven stone. The Elgin collection became the property of the British nation for 86,000 pounds sterling in 1816, and has been the British Museum's most priceless of art treasures ever since.

The Louvre Museum, across the Channel, has the single slab of marching Athenian maidens which Choiseul secured. It is likely enough that France and not England would have got the whole treasure if Nelson had lost the battle of the Nile in 1799. The present Duc de Laborde has a fine female head from one of the Parthenon pediments at his Paris *hotel*. This relic reached France by way of Venice. Some scholars believe it to be a remnant of the Victory who drove Athena's car in the west gable.

Besides the Choiseul slab, the Louvre owns the detached head of a Lapith from one of the centaur metopes at London. An American specialist, Dr. Charles Waldstein, first fitted the two together.

So much for the Parthenon sculptures at Athens, London and Paris.

Very few other fragments of the world's most renowned group of decorative sculptures have been located. The celebrated horseman of the Vatican was once classed as one. But it was only the tombstone of some Athenian roughrider. Palermo has a pretty fragment of the eastward Ionic frieze, the Duke of Modena at Vienna has another of the south frieze; a third frieze fragment was recovered from a garden rockery in the north of England a few years back. Carlsruhe and Copenhagen have pieces of Parthenon metope slabs from the Doric frieze of the temple.

Dr. Jan Six, the son of the Amsterdam medalist, and a descendant of Rembrandt's familiar Burgomaster Six, has the merit, and the rare good fortune, of locating a very important, new fragment of the Parthenonian pediment groups, in the Royal Museum of Stockholm. A female head which he has just published in *The Journal of Hellenic Studies* has hitherto borne the perfectly arbitrary name of "Dejanira." The Stockholm marble has the same characteristic blocked modeling as the badly weathered head of the London "Theseus," and that statue is the only complete pedimental figure with a head on its shoulders. The new marble agrees, in this resemblance, with the Duc de Laborde's female head. This *air de famille* is, indeed, the clinching argument for the attribution of both the detached heads to the studio of the Parthenon sculptors. For of heads and statues chiseled over life size in Pentelic marble there are many. It is the eye that must decide. Kalkmann and other classical archæologists have enriched the machinery of their favorite science with tables of comparative dimensions which are a lame substitute, at best, for the immediate perceptions of that sensitive organ. We suppress the dry figures in the present case.

Persons familiar with Anna Akerhjelm's letter to her brother Sam, containing a contemporary account of the explosion and wreck of the Parthenon by a Venetian shell, in 1687, will find the Dutch critic's lucky location of a trophy of the fall of Athens in Sweden no more surprising than Weber's purchase of a similar one at Venice. Anna was a Swedish companion of Countess Konigsmark on board of Francesco Morosini's squadron. Count Konigsmark himself commanded a force of Hessian mercenaries under Morosini. One of his Germans pointed the fatal mortar which compelled the Turkish garrison's surrender of the citadel on September 28th of that year. A deserter had brought Konigsmark the information that the great temple was the enemy's chief casemate and powder magazine. Three hundred souls lost their lives in the historic explosion. The number included the harem of the Turkish commandant.

One may indulge the fancy that Sam Akerhjelm's sister carried the Stockholm head to Sweden, just as some other follower of Morosini must have taken the Weber-Laborde head to Venice. As a matter of record, the broken Greek head was in a collection made at the royal Swedish castle of Drottningholm by Frederick the Great's sister Queen Louisa Ulrica of Sweden, before her accession in 1749.

William Napier Shaw, F.R.S.

The Head of the Official Meteorological World

By C. Fitzhugh Talman

WHEN the lamented Mascart, shortly before his death in 1907, relinquished the presidency of the International Meteorological Committee—an association comprising the directors of the principal national weather services of the world—the choice of his successor entailed no delay or discussion. The committee was singularly fortunate in having among its members a man ideally fitted to occupy the by no means easy position of head of official international meteorology. Others had contributed more conspicuously than Dr. Shaw to the advancement of the world's knowledge of the atmosphere; but no one even approached him in those personal qualities that stand for successful leadership.

Dr. William Napier Shaw, president of the International Meteorological Committee and director of the British Meteorological Office, is a man whose personality compels attention. Physically, he is above the average in build and stature. Anyone who is prone to notice canine affinities in the human species would unhesitatingly class him among the mastiffs. Temperamentally, he is placid and self-contained, suave and tactful, under all the harassing circumstances that beset him as an administrator, national and international. Intellectually, he is the kind of man in whom we like to see the realization of the ideals of the English universities. His *métier* happens to be physical science; but this fact does not warp his appreciation of the humanities. In his public addresses he is prone to quote poetry. The quotations are always felicitous, and fit in quite naturally with the speaker's graceful prose, which has itself a poetical undercurrent.

Born at Birmingham in 1854, he was educated first at King Edward's School, in his native town, and then at Emmanuel College, Cambridge. His studies in physics were rounded out at the University of Berlin, under Helmholtz, whence he returned to Cambridge as fellow of Emmanuel, becoming later university lecturer in experimental physics, and then assistant director of the Cavendish Laboratory.

In 1885, after the introduction of "New Statutes for the University and Colleges," he married Sarah, second daughter of Dr. T. Harland, of Salford, herself attached to the teaching staff of the university, as lecturer in mathematics at Newnham. Mrs. Shaw has kept up her interest in educational matters, and is an active leader in the educational section of the British Association. She is also an ardent amateur photographer, and we are indebted to her skill in this direction for the portrait of her husband that accompanies this article.

From the beginning of his academic career, Shaw displayed an interest in certain applications of physics to meteorology, and he carried out special investigations for the Meteorological Council of the Royal Society long before he dreamed that he should one day be called to the directorship of the Meteorological Office. The first course he gave as lecturer on natural science at Cambridge was on meteorological instruments, in 1897. Fortunately, however, for his subsequent career as a meteorologist, he was at the same time laying the secure foundations of a general knowledge of physics and mathematics—the necessary propedeutics of all serious work in meteorology. A glance at the list of his contributions to scientific literature during his residence at Cambridge reveals an extraordinarily wide range of interests; electrolysis, ventilation, acoustics, pyrometry, thermodynamic problems, were a few of the subjects that he attacked with especial zeal, and to which, in each case, he added something of his own. As early as 1895 he published, conjointly with Glazebrook (now director of the National Physical Laboratory), a textbook of practical physics, which has passed through several editions.

When in 1891 he was elected a fellow of the Royal Society he held a commanding position among physicists, and his genius as an educator was conceded to have placed the teaching of physics at Cambridge upon a more dignified footing than had ever before been granted to it—but he was hardly yet accounted a meteorologist. In 1897 he succeeded Stone, the Oxford astronomer, as a member of the Meteorological Council of the Royal Society—which was, in those days, the governing body of the Meteorological Office. Not until 1900, however, did he definitely embark upon a meteorological career. In that year R. H. Scott retired from the position of administrator of the Meteorological Office (as secretary of the council), and Shaw was called from Cambridge to succeed him.

From the moment that he took up his new work in what, in a recent tribute to a deceased colleague, he has called "the unpretentious room over a piano shop in Victoria Street which for more than forty years has been the chief center of meteorological work in this country," the Meteorological Office awoke to new life. Official meteorology is not generously treated by the British government. It is supported by an annual Parliamentary grant which, together with miscellaneous revenues from other sources, amounts to less than $100,000; i. e., about one-sixteenth as much as Congress appropriates annually for the United States Weather Bureau. How, with the meager means at his disposal, the director of the Meteorological Office is able to keep up even the routine of a great national weather service is a mystery to his cisatlantic confreres. This routine work includes among other things the preparation and publication of daily, weekly, monthly and annual reports, containing the results of observations at a few large observatories and a great number of small stations. In response to the frequently expressed desire of the International Committee for the prompt publication of data, Dr. Shaw has gradually brought up the arrears of these reports, which now appear so punctually that they set the pace for all publications of similar character throughout the world. Formerly one had to wait three or four years for the *de rigueur* returns of the English meteorological observatories, now one gets them in as many months.

The compilation of these returns, the daily weather forecasts, and the superintendence of the instrumental equipment, along with incidental clerical duties, might well be expected to absorb all the energies of the little staff of meteorologists and clerks, formerly housed in the cramped quarters "over a piano shop" for which Dr. Shaw's epithet "unpretentious" was somewhat unduly charitable—but, since last year, more happily installed in new and relatively spacious premises in South Kensington. Such, however, is far indeed from being the case. At brief intervals the office publishes memoirs on special topics, ranging over a wide field, and so pregnant with timely interest as to give outsiders the impression of being the fruit of ample leisure rather than of odd moments snatched from the "trivial round."

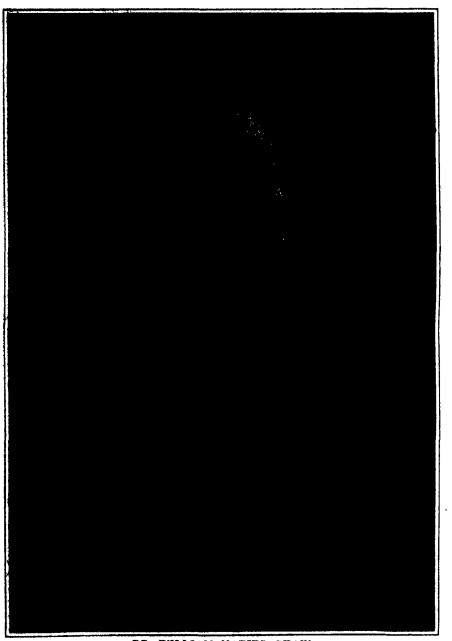
If it be asked what all this has to do with the subject of our sketch, the answer is that all the publications of the office bear, at least the unmistakable marks of his directive genius, and not a few of them have come chiefly from his own pen. In an address before the British Association a few years ago he expressed his views as to the relation of routine to extra-routine duties at the office in the following words:

"There is a tendency among some of my meteorological friends to consider that a meteorological establishment can be regarded as alive, and even in good health, if it keeps up its regular output of observations in proper order and up to date. That is a view that I should like to see changed. To me, I confess, the speculation which may be dignified by the name of meteorological research is the part of the office work which makes the drudgery of routine tolerable. For my part I should like every worker in the office, no matter how humble his position may be somehow or other to have the opportunity of realizing that he is taking part in the unraveling of the mysteries of the weather, and I do not think that any establishment, or section of an establishment, that depends upon science can be regarded as really alive unless it feels itself in active touch with that speculation which results in the advancement of knowledge."

Since his election to the presidency of the International Meteorological Committee in 1907 Dr. Shaw has displayed, on a larger scale, the same genius for organizing and directing scientific work that distinguished him when, in his earlier years, he built up the department of physics at Cambridge, and that he later brought to bear upon the task of reorganizing and revivifying the Meteorological Office. Meteorology stood in need of just such a leader. He is not, as the typical Englishman is reputed to be, unduly wedded to the past. On the contrary he is sometimes criticised for being in advance of his times. He has, for example, led the movement that aims to reform the units of measurement employed in meteorology and stands ready to throw overboard the whole cumbersome system of inches and feet and Fahrenheit degrees, he has, in fact, already done so in the upper air work of the office.

A few evidences only can be quoted in this brief sketch of the advanced position that he has come to occupy in the general campaign of meteorological research. There is urgent need of gathering in the scattered results of climatological observations made in countries that have no regular weather services. In recognition of this need Dr. Shaw has set the example by undertaking to publish all such data obtainable in the smaller British colonies, and heretofore almost wholly inaccessible to the scientific public.

(Continued on page 176.)



DR. WILLIAM NAPIER SHAW

President of the International Meteorological Committee.

Integral Photography

A New Discovery by Professor Lippmann

By the French Correspondent of the Scientific American

PROF LIPPMANN of Paris is working on a very remarkable new photographic method which he has termed "integral photography" The nature of this is best explained by reference to the accompanying diagram It should be remarked in the first place that the process is designed to work without a camera. The sensitized plate is coated with a large number of very small globules of glass or other transparent material In use each of these acts as a miniature eye, with a sensitive plate for its retina The globules are very small, less than one hundredth of an inch in diameter In front each has a little blob which acts as the lens of the miniature eye Suppose an object to be situated at *M M'*, as indicated in the diagram Consider any globule Rays from the points *M M'* will pass through the minute lens, and an image will be formed at the back of the globule upon the sensitized plate at *M M'* Thus each globule will contain a minute picture of the objects placed in front of the plate This picture is brought out by developing the plate and fixing it in the usual way This of course yields a negative, which must be reversed by the use of a suitable reversing bath The result is a transparency, in which all the minute pictures in the individual globules are combined into one image of the original object To view it, a good light is placed behind the plate, so as to send light through all the globules Suppose the eye viewing the transparency to be placed at *O*, the point which when the picture was taken, lay on a line joining one globule with the point *M* of the object The process which now occurs will be the opposite of what happened when the picture was taken In other words the eye will receive from the globule a view of the image *m* of the point *M* Other globules will send images of the point *M'*, etc, at the same time, so that the eye will see the different portions of the image coming from all the different globules In this way a complete image of the object originally presented to the plate is seen If the eye is placed at some other point *O'*, or if *O'* represents the position of the other eye, the object will also be seen, but the light received at the eye will come from somewhat different portions of the globules, and the appearance presented will differ accordingly from that seen at *O* The difference is of precisely the same kind as that which distinguished the appearance of the same object when seen from two different points In other words, when passing from *O* to *O'*, the observer will receive the same impression, in looking at the transparency, that he would if he were to move in this way while looking at the original object For example, in one position a certain object might be hidden behind a tree, in the second position this object might become visible Again, if *O* and *O'* should represent the positions of the two eyes, each will receive a slightly different impression, with the result that a stereoscopic effect is secured This is explained by the fact that certain portions of the landscape appear in certain of the globules, but not in others The image which the eye sees is made up of points coming from different globules, and as the eye moves, and different pairs of each globule are viewed, the contribution which each sends to the eye is changed in accordance with the direction in which the eye is looking at the globule

After working out this remarkable principle, Prof. Lippmann presented it before the French Academy of Sciences and other scientific societies, where it awakened great interest. The realization of the process presents considerable technical difficulties Owing to their small size, it was out of the question to shape each one of the globules separately Prof Lippmann tried using minute glass beads, such as are found in commerce and used for covering ornamental surfaces, such as picture post cards He found, however, that these were too irregular in shape and size Another idea which suggested itself was to stamp out a transparent sheet of collodion and gelatine, giving the surface the requisite shape But the dies required were found to be too difficult to make in the laboratory, so that Prof Lippmann has been forced to abandon his attempts in this direction for the time being The fact is that the working out of a process of this kind is a technical

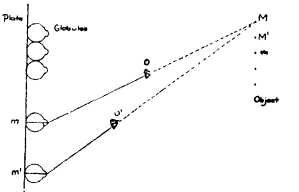


Diagram to illustrate the principle of Lippmann's integral photography.

rather than a scientific problem. There is a good field here for inventors to exercise their ingenuity, for if a Lippmann photographic plate could be made it would be of great value, inasmuch as in order to take a photograph the plate is simply exposed to a landscape or other object, without any camera at all, and the picture obtained possesses the remarkable properties explained above

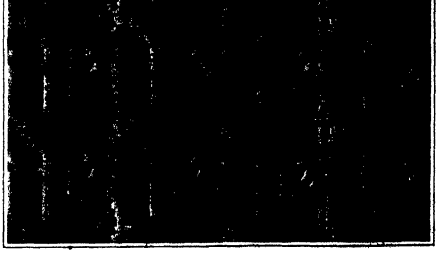
In the meantime Prof Lippmann has been making some interesting experiments with an apparatus which is intended to show some practical results of the principle expounded, and without use of such minute globules he has succeeded in producing some very striking effects A number of ordinary lenses (even spectacle lenses may be used) are cut into square shape, so that they can be fitted together into a continuous surface A number of such lenses are put in the front wall of a camera, as shown in our illustration The more lenses are used, the better is the result obtained, but twelve is found to be a sufficient number These lenses correspond to the globules spoken of above, each image being formed on a separate portion of the photographic plate at the back of the camera Each lens makes a picture on the plate, the portions of the plate illuminated by the several lenses being kept separate by an arrangement of black cardboard cells or partitions. One of our views represents the front of the camera with a set of twelve lenses, while the rear view shows the cells in the plate-holder This latter carries a large plate of such size as to receive all the twelve pictures, and is placed in the camera as usual. The plate-holder, however, is made with a slide in the back as well as in the front, for a purpose which will appear presently After the picture is taken, the negative is developed as usual, and is reversed either by means of a reversing bath, or by copying it, so that a transparent positive is obtained. The twelve pictures are not quite alike, for each lens forms its image from a somewhat different point of view The transparency is put back in the holder, both slides of which are now opened, while light is sent through from behind The observer looks in through the lenses with both eyes, when he sees a single view in relief of the object photographed. On moving the head from side to side, or up and down, the same effect is observed as would be under similar circumstances when looking at the real object, that is to say, objects which cover one another when looked at from one point, are seen to separate when viewed from another Even with this simple apparatus the effect is very pleasing.

Proposed Aeronautic Map

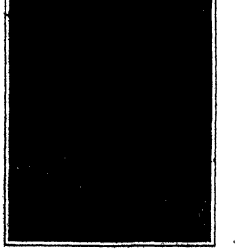
AT a recent meeting of the Academie des Sciences, M Lallemand, chief of the French Government Survey Department, presented the project which the Aeronautic Commission intends to carry out establishing an aeronautic map The proposed map is of 1:200,000 size, and is drawn up after a provisory model made by the Aero Club Each plate of the aeronautic map will be a sheet taking in one degree in latitude and longitude and there will be twenty-four such sheets included in one sheet of the world's map. This latter sheet occupies 6 degrees longitude by 4 degrees latitude. The longitude will be counted from 0 degrees to 360 degrees toward the east starting from the meridian lying exactly opposite to Greenwich, and the latitudes, or rather the distances from the South Pole, will be numbered from 0 to 180 degrees toward the north. Each sheet will carry a number which designates it On the other hand, on the ground or the roof of a building will be traced a large square, and the position of that particular locality on the map is shown by a large circle or disk To the left will be placed a large number showing the units of the latitude and to the right the figure for the longitude, but using only the unit figures in each case, as an error of 10 degrees, or from 600 to 700 miles, could hardly be made by a pilot as to his position, so that such figures will be enough to guide him. Thus he finds what leaf of the map he is to use for this locality. In order to make a trial of the new plan, it was decided that three specimen sheets of the map should be made by the Aero Club, and these will be put in the hands of the army pilots during the next annual maneuvers



Prof Lippmann's camera, showing the front with its twelve lenses



View in Prof. Lippmann's laboratory. A twelve-fold image formed by as many lenses.



The rear of the camera, showing the cells and plate-holder.

APPARATUS AND RESULTS OF THE NEW LIPPMANN METHOD OF PHOTOGRAPHY

Water in Motion

Some Examples of the Tremendous Energy of Waves and Floods

MEASUREMENTS of the size of waves have now been made systematically for many years, but they relate chiefly to the waves of the open sea, where the depth of the water is so great that the friction of the sea bottom exercises no modifying effect

A few months ago the North German Lloyd liner "Brandenburg" came into New York harbor with her crow's nest, 50 feet above the water-line, stove in, and bearing many other marks of the damage wrought by a monster wave that broke over her bows about 1,000 miles east of Sandy Hook The officers estimated the height of the wave at 65 feet This height is exceptional, but not unprecedented, for it must be remembered that the breaking of a wave against an obstacle throws the water to a far greater height than the unbroken wave could attain.

Unbroken waves due to the wind may, in extreme cases, reach a height from trough to crest of 40 to 50 feet Much higher waves occasionally occur as a result of earthquakes or seaquakes. "Solitary" waves of this character have sometimes been encountered in otherwise tranquil weather, taking vessels by surprise and not infrequently sending them to the bottom

According to Vaughan Cornish, who has probably devoted more attention to this subject than any other contemporary man of science, the average height of the waves encountered in a severe storm at sea is 20 feet, but the ordinary maximum height of the waves in the same storm will attain 30 feet In a storm of very exceptional violence the average height may reach 30 feet, and the maximum height 45 feet. This is regarded as about the limit of the height of waves due to wind only Cornish finds that in the open sea the height of a wave in feet is about one-half the velocity of the wind in miles per hour The following table, computed by W. H. Wheeler from a great number of observations, shows the relation of the wind to the dimensions and speed of ocean waves.

Wind.			Waves			
Speed.*		Force, Pounds per Sq. Ft.	Height in Feet	Length in Feet	Speed.	
Feet per Second.	Statute Miles per Hour				Feet per Second	Nautical Miles per Hour
2	1½	0 02	0 08	1 5 4	2 32	1 4
6	4	0 08	1 98	52 2	9 56	5 6
18	9	0 36	4 99	119 1	15 08	9 0
30	14	1	9 69	174 0	23 91	13 9
37	17	1 60	8 61	254 9	31 32	18 5
80	90	9	9 00	261 0	34 80	20 8
95	94	8	11 95	304 5	40 40	24 0
44	30	5	14 58	382 8	51 00	30 6
59	40	8	19 47	513 3	68 44	41 0
88	67	28	31 35	803 5	110 20	66 1
118	80	36	The proportions of these waves are so curious that averages cannot be given			
147	100	50				

So much for waves on the high seas These waves, though they may race along at the speed of an express train, do not carry the surface water far with them, each particle of water describes a local circular orbit during the transit of the wave, so that what advances is rather the form than the substance

The case is quite different when waves break upon a shore, where the shoaling water produces "waves of translation" These waves are relatively short and steep, and break when they enter water the depth of which is equal to, or a little exceeds, their height from trough to crest They approach the shore in a direction nearly at right angles to the general shore line, whatever the direction of the wind This is explained by the fact that, if the wave is at first directed at an acute angle to the shore, when it reaches shallow water the side of the wave nearest the shore is first retarded, so that the wave tends to swing around until it faces the shore

In planning harbor construction and the protection of coasts it is customary to consider the amount of exposure to which the coast is subject, i e, the extent of open sea in a straight line at right angles to the shore This is called technically the "fetch" The relation of the fetch to the possible height of the waves was announced by Stevenson in 1852 According to his formula the height of waves in a gale, in feet, is one and one-half times the square root of the length of the fetch in nautical miles

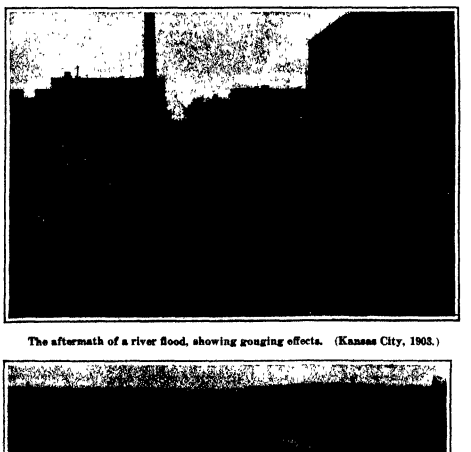
The force of a great wave breaking against a sea wall or other construction is so terrific as to tax the strength of the best planned work of the engineer A marine dynamometer for measuring the force of impact of such waves was devised by Stevenson over half a century ago, and modifications of this instrument have since been introduced by several investigators According to Stevenson, the maximum force of an Atlantic wave is three tons per square foot French engineers find that the force of the waves on the breakwater at Cherbourg may attain three and a half tons per square foot.

Some interesting examples of the height to which breaking waves may be thrown, and the work they may do in moving heavy objects, are given by Wheeler in his 'Practical Manual of Tides and Waves'

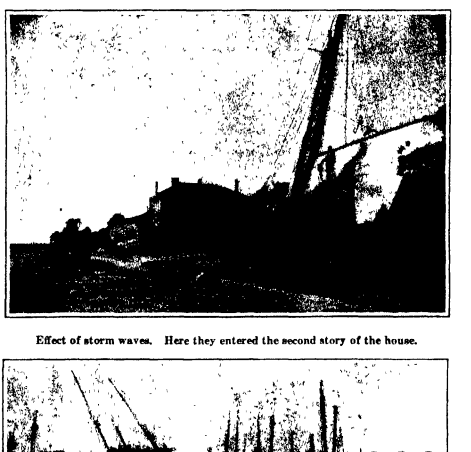
Stevenson records a case in which water was thrown to a height of 106 feet at the Bell Rock Light At the Alderney breakwater it is said that water has been thrown upward 200 feet At Peterhead, where the "fetch" is 300 miles, waves of 30 feet in height and from 500 to 600 feet in length have been recorded, the water has struck the breakwater with such force as to be thrown upward 120 feet, and blocks of concrete weighing 40 tons have been displaced at levels of 17 to 36 feet below low water

At Wick two stones, weighing eight and ten tons each, were thrown over the parapet of the breakwater, the top of which was 21 feet above high water, while blocks of concrete weighing respectively 1,350 and

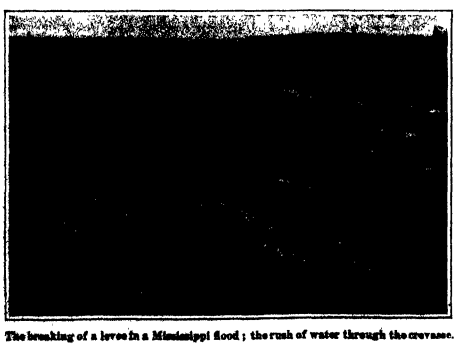
* These particular intervals of wind speed were chosen as representing the successive steps of the "Beaufort scale," according to the equivalents formerly assumed for this scale As the latter are now known to have been much too great, we have omitted the Beaufort numbers from Wheeler's table.



The aftermath of a river flood, showing gouging effects. (Kansas City, 1903.)



Effect of storm waves. Here they entered the second story of the house.



The breaking of a levee in a Mississippi flood; the rush of water through the crevasse.



Havoc wrought by storm waves in a Gulf hurricane.

SOME EXAMPLES OF THE TREMENDOUS ENERGY OF WAVES AND FLOODS

2,500 tons were displaced, though there is some doubt whether the latter movement was due entirely to wave action

At the Bishop Rock lighthouse, which is exposed to the full force of the Atlantic waves, an iron column weighing over three tons was thrown up 20 feet and landed on top of a rock.

At the harbor works of Bilbon, in 1894, a solid block of the breakwater weighing 1,700 tons was overturned from its place and dropped into the water

At Ymuiden breakwater a block of concrete weighing twenty tons, placed outside the harbor walls, was lifted by a wave to a height of 12 feet vertically and landed on top of the pier, which was 5 feet above high water.

The above cases illustrate the sheer force of the individual wave as an engine of destruction, but the imagination of mankind is more impressed by the widespread effects wrought by the great storm waves that sometimes inundate low-lying coasts These waves are often miscalled "tidal waves," the only justification of the latter name being the fact that their effects are most pronounced when the wave propagated outward from a storm area happens to coincide with the occurrence of flood tide on the coast affected

The precise mode of origin of the storm wave has been the subject of much discussion, and even now is not fully understood Such waves attend every severe cyclonic storm at sea, and as they travel much faster than the storm (i e, the storm as a whole, not the wind revolving about the storm center) they often occur on a coast when the weather is otherwise serene, and thus serve as a valuable prognostic of the storm's approach, in case the coast happens to lie in the storm track.

It is well known that the barometric pressure is much lower at the center than at the periphery of a storm—the difference sometimes amounting to two inches or more—and this difference of pressure must disturb the equilibrium of the water, causing it to become heaped up at the storm center This bulging of the water would amount, theoretically, to about one foot for each inch of barometric depression However, although this process doubtless contributes to the production of the wave, the violent winds at the vortex of the storm are probably a much more important factor

The mechanism of storm waves was studied by a board appointed by the Chief of the United States Weather Bureau for this purpose in 1901; and the reader is referred to the report of the board, published in the *Monthly Weather Review* of October, 1901, for further information on the subject

We are concerned here chiefly with the effects of storm waves (which the newspapers and the public call "tidal waves," but persistently, and with as much reason, as they call tornadoes "cyclones") These are most severe when the wave moves toward a low-lying coastal region, having a converging shore-line, this convergence producing the same effect as seen in a tidal "bore"

The most disastrous storm waves have occurred along the coast of the Bay of Bengal, on the extensive flats lying about the mouths of the Hugli, the Meghna, etc The storm wave of October 7th, 1737, is said to have risen 40 feet in the Hugli, sweeping away 300,000 souls In May, 1787, at Coringa, near the mouth of the Godavery, such a wave is said to have taken toll of 20,000 lives The Calcutta cyclone of October 5th, 1864, caused the inundation of the flats on both sides of the Hugli estuary, with a loss of about 48,000 human lives, and the destruction of 100,000 head of cattle The greatest disaster of recent times in this much-afflicted region was the Backergunge hurricane of the night of October 31st-November 1st, 1876, which cost the lives of over 100,000 persons In this storm the water rose from 30 to 40 feet in less than half an hour

The islands of the Pacific are also subject to visitations of this character on a huge scale, in connection with tropical hurricanes The latest of these was the storm of March, 1910, which was especially remarkable for the vast area that it covered, its track extending some 2,500 miles, from Fiji to New Caledonia, Norfolk Island and the North Island of New Zealand Statistics of the loss of life and property in this storm are not yet available

Our own seaboard has repeatedly suffered from the effects of storm waves. In the Galveston hurricane of September, 1900, a series of waves invaded the city; 6,000 lives were lost, and the destruction of property amounted to $30,000,000. The damage was due to wind as well as water, but chiefly to the latter.

It remains to say a word concerning quite another kind of wave, viz., that which moves down a river in flood, often causing widespread inundations of the adjoining shores

The total volume of water discharged by a great river is so enormous that it is commonly expressed in units of a million cubic yards. The normal annual discharge of the Mississippi system is 785,190 of these units The occurrence of a flood depends upon many factors, which fortunately rarely combine their maximum effects at a given moment. Thus the maximum *possible* discharge of the lower Mississippi is about 3,000,000 cubic feet per second, which is about one-third greater than has ever occurred, so far as known.

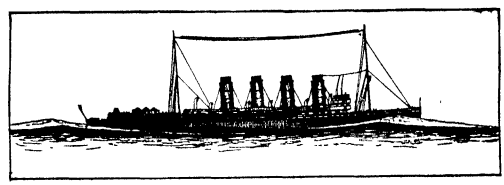
The most destructive river floods of which history furnishes any record are those that have occurred in China, especially those of the Hwang-Ho—"China's Sorrow" We hear of occasional changes in the course of the Mississippi, whereby a property-holder is presented with, or robbed of, a few acres of alluvial land over night, or a cut-off shifts a few square miles of land from one bank to the other; but what shall we say of a river that has bodily abandoned hundreds of miles of its channel no less than nine times, thus changing the position of its mouth to the extent of five degrees of latitude? The havoc wrought by these migrations of the Hwang-Ho—to say nothing of the floods that have not involved a general shifting of the channel—staggers imagination It is most conveniently stated in terms of human lives swept away; and we are told that during the fifteen years beginning with 1851 (including the last great change in the course of the river) between forty and fifty million human beings fell a prey to the fury of the waters.

The floods of the Seine, of recent memory, as well as all other similar disasters of the western world, sink into insignificance in comparison with this record.

What of the means of ameliorating the regimen of our rivers—diminishing their liability to flood? Forestation used to be considered the panacea, but to-day our judgment is suspended on this question The doctors disagree

River engineering has worked wonders If the destructive flood comes in spite of the engineers, then we can only look to the flood forecaster to give us timely warning—and stand from under

River stage prediction has reached—above all in America—a degree of accuracy that nearly reconciles us to the floods in consideration of the pride we feel in this particular branch of scientific achievement This, however, is subject matter for another story.



White wave line—wind 67 miles per hour; height of wave 31.35 feet; length of wave 826.5 feet
Black wave line—wind 30 miles per hour; height of wave 14.55 feet; length of wave 382.8 feet.

No Two Finger Prints Alike

SINCE the time when the late Sir Francis Galton proposed the use of "finger-prints" as means for identifying criminals, soldiers, and people generally, there has been great hesitation on the part of many people to accept the absolute individuality of the markings on the finger tips as certain To most of us it is very hard to conceive that there cannot be two fingers that are exactly alike When the police try to fix the guilt for a crime by showing the identity of the finger-print of the accused with that left on a window or a weapon, for example, many people consider the evidence as far from conclusive A recent murder case in New York city involved finger-prints as evidence of identity, and the attorneys of the defendant appealed the case on the ground that the evidence left room for "reasonable doubt"

A communication to the French Academy of Sciences by M V Balthazard is of interest in this connection This student finds that if any finger-print be divided into a hundred squares, each square will contain some distinctive mark, rarely two marks and only in very exceptional cases three or none These marks are either the branchings of the ridges that you can see on the tip of your finger, or terminations of ridges. Two finger-prints differ from each other either in the arrangement of the marks in the different squares, or in the character of the marks in a particular square. The total number of combinations of the two kinds of marks in the hundred squares is the one-hundredth power of 4 (4^{100}). This is a number that no one can possibly imagine; it is equal approximately to a number that would be represented by the figure 1 followed by sixty zeros. This means that there are possible just so many different kinds of prints, and that no particular combination will occur more frequently than others. The chances, therefore, of any particular combination of marks occurring, may be represented by a fraction with one as the numerator and a denominator represented by 1 followed by the sixty zeros—a very tiny fraction of a chance indeed.

Now in order to compare this very slim chance with human chances generally, we must consider the population of the whole world. At the present time this is estimated to be, in round numbers, 1,500,000,000 There are about three generations in a century, or say about five thousand million different human beings As each of these has, on the average, not more than ten fingers, that makes a possibility of about 50,000 million different finger prints in a century. In order to have enough human beings to furnish the fingers necessary for realizing all the possible combinations of marks, we should need a number of years represented by the figure 2 followed by forty-eight zeros. The chances for finding two finger-prints exactly alike would be about once in that length of time.

This period is of course inconceivable, and from a practical human point of view it is as long as "eternity" This length of time is vastly greater than the total length of the period since there was any kind of life upon the earth at all; it is even much longer than the length of time that astronomers calculate as necessary for the complete freezing of the sun.

But if it would take that long, approximately, before two human finger-prints appeared that were exactly alike, one may still ask how near alike may two finger prints be. Or to put the question in its practical form In how many points must two finger-prints agree to make sure of identity? Dr Balthazard shows on purely mathematical grounds that when two finger prints agree in 17 of the 100 squares, it is practically certain that they were made by the same finger His reasoning is as follows

If we look for a single coincidence, we may find it on examining four fingers To find two finger-prints that have two coincidences, we must examine at least sixteen fingers. To find three coincidences between two finger-prints, we must examine at least sixty-four prints, etc. These numbers, it will be noticed, represent the *powers* of 4 corresponding to the number of coincidences sought Thus, $4^1 = 4$; $4^2 = 16$; $4^3 = 64$; $4^4 = 256$, etc. The probability or "chance" of any number of coincidences occurring is 1 divided by 4 raised to the power of the number of coincidences In this way we must find the number of coincidences whose probability is as 1 divided by the total number of fingers on the earth at any one time This number is slightly less than seventeen, for the seventeenth power of four (4^{17}) is 17,179,869,184. (The total population being taken at fifteen hundred millions, this number is multiplied by ten—the number of fingers for each person—giving us 15,000,000,000 fingers at any one time.)

In actual practice it may not be necessary to find as many as seventeen coincidences to make sure of identity If the two finger-prints that are being compared are known to have been made by Europeans, or by Americans, or by inhabitants of a certain district, the number of coincidences necessary to establish identity is much fewer. Bertillon found two finger-prints made by different men, having as many as thirty coincidences This would seem to be at variance with the law of probability; but on examination it appeared that the two men were twin brothers.

However, the mathematical demonstrations may not be quite convincing to many persons. The doctrine of probability may be acceptable enough, but it remains to be shown whether all the combinations that are theoretically possible do actually occur in equal numbers; that is, whether there is not a tendency for certain combinations to occur more frequently than others, and whether, therefore, certain coincidences are not more likely to occur than others. Still, the numbers involved are so enormous, that for all practical purposes we may feel quite assured that what is likely to happen only once in a long, long eternity is *not likely* to happen twice in a century.

Correspondence

[The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.]

Cosmic Speculation

To the Editor of the SCIENTIFIC AMERICAN.

To modify if not entirely to prevent dangerous thaws, intense heat-waves, extensive droughts, and seismic disturbances, should be the primary aim of mankind in the present century.

Solar rays, striking the earth at right angles, have the effect, in one region, of suddenly dissolving and releasing huge ice-jams; in another, of overheating and evaporating vast quantities of water. This mass, in its new form, accumulates heat and electricity. If the phenomenon were to recur indefinitely, it would probably result in the total disintegration of the terrestrial mass. However, there may be noted, as counteracting the influences described: (1) the revolving motion of the earth about the sun, (2) the attraction exerted upon it by the moon, and (3) the irregular formation of its crust.

Yet the proceeding does repeat itself for days and months. When the former is the case, the phenomenon brings in its trail widespread inundations and the insufferable heat that annually numbers its victims by the thousand—particularly in this very country. And in the latter instance, when the occurrence continues for a considerable length of time, an exhaustion is produced of the general humidity as well as of the aqueous deposits left by previous rains in the soil and subsoil. These deposits ordinarily feed the internal streams and lakes whose function is refrigeration.

In reducing these cooling influences, the draining off of inner bodies of water heightens the internal heat, and with it the extent of evaporation and electricity; until the moment arrives when equilibrium is upset between the inner and outer electrical states, giving birth to a wave that precipitates commotion and disturbance.

On occasion, the phenomenon takes on more serious proportions, because of greater intensity in the sun's heat or through special circumstances existing in the interior regions. These contributory causes facilitate the action of "the mighty fluid" and combine with it to hurl outward the very bowels of the earth, to make room for the processes of deformation and disintegration.

In view of the advanced state of the sciences and the increased means of action at the disposal of man, the phenomenon should allow of easy modification. The remedy is to be sought in two directions: (1) By loud reports in the upper strata of the atmosphere, we may attract currents of air bringing cold from the regions that are far distant from the scene of overheating. (2) The natural course of events can further be modified by collecting, simultaneously with the explosions on high, the electricity stored in the atmosphere and in the bosom of the earth.

Small acts determine large effects. Deprive a huge boulder of a little stone that contributes to its equilibrium, and the mighty mass will overturn. Let a man shout, a gun give forth its report or a tiger roar, at a given place and at a given moment; immediately there will be unchained a down-pour, a tempest lasting hours.

A decade or more must elapse before we can determine the precise spot and occasion for such action. For perhaps a pair of decades our plans must hold fire, until we can reach into the depths of the earth with a receiver. Yet both ends shall certainly be attained. In the meanwhile, advantage can be taken of the art of aviation and of craters and their data to study the laws of the atmosphere and general geological chemistry.

The task set before us is not one for the individual. Rather does it confront the nations. World conventions, competitive contests for generous prizes, observatories and laboratories already in existence and yet to be created, all to be united into one association better to see and better to labor—such is the path to be followed.

New York city. R. FERRES CORDERO.

The Bridgeport Railroad Wreck

To the Editor of the SCIENTIFIC AMERICAN:

In your article entitled "An Imminent Railroad Danger" in the issue of July 22nd, you speak of the "perfection of the track and equipment of our leading railroads." I feel, however, that, as far as the Federal Express is concerned, the description "perfection of equipment" does not apply. Being interested in such matters, I have frequently noticed particularly the equipment of this train as it stood in the South Station, Boston. The train usually consists of a large Pacific type locomotive followed by a baggage car (sometimes a Pennsylvania steel car), a New Haven wooden vestibuled day-coach (not of the most modern type) and then several Pullman sleepers, some of which are, sometimes, of the all steel type built for use on the Pennsylvania Railroad. According to your opinion repeatedly expressed in your paper, such a sandwiching of a weak wooden day-coach between a heavy locomotive and heavy Pullman sleepers is about the most dangerous arrangement that could be devised. The fact that nearly all the deaths occurred in the day-coach shows the validity of your contention, which, however, is not difficult to understand in the abstract.

As for the matter of human control, it seems that it ought to be possible and not seriously inconvenient to so arrange the controlling levers in the cab that it would be necessary for the engineer to exert some little pressure on them to keep the throttle open and the brakes off. Then, if, through his unconsciousness or sudden death, the pressure were released, the train would automatically be brought to a stop.

Braintree, Mass. AUBREY D. BRIDELMAN.

Possible Size of Battleships

To the Editor of the SCIENTIFIC AMERICAN:

Apropos of the limits of size of battleships, at least for the American navy, it would seem the Panama Canal sets very certain restrictions. The locks have a length of 1,000 feet, a width of 100, and a depth of 40.

Supposing the maximum draft of a battleship to be 30 feet, its length to breadth 6 1, and its beam the maximum 100 feet, we have a limit (using the coefficient of fineness 0 600) 30,000 tons. If we extend the length and breadth to 7 1, we have with the same draft of 30 feet 36,000 tons. Suppose the draft to be enlarged to 35 feet, for the first set of proportions we have again 36,000 tons, and the second set (7 1) 42,000 tons. It is hardly possible that the length of a battleship with regard to its beam will exceed 7 1 with due regard to stability as a gun platform. Coincidently, 35 feet in all probability will be the maximum possible draft, having taken into consideration the depth of our harbors, and the possibly increased draft of a disabled warship.

As it is, with the maximum dimensions of 100 feet beam, 700 feet length, and 35 feet draft, there is no dock in the United States as far as I know that will take such a ship. Hence it appears that these are the outer limits of dimensions for our battleships, for after having constructed the canal, it would be superlative madness to neutralize it by building ships which could not use it. By increasing the coefficient of fineness, a somewhat larger tonnage might be obtained. Hence it would seem that the utter limit in size of our battleships is roughly 40,000 to 45,000 tons. From 1907 to 1911 the tonnage has jumped from 20,000 to 30,000—50 per cent. At the same rate of increase, in 1915 the limit will have been reached, and the battle of displacement will have given place to the battle of calibers.

Pittsburg, Pa. WILLIAM BERGEN CHALFANT.

Photography of the Invisible Ray

To the Editor of the SCIENTIFIC AMERICAN:

I was much interested in an article appearing in the SCIENTIFIC AMERICAN under date of June 10th upon "Photography by Invisible Rays," with photo illustrations of the theory. If you will look in a "Science Record" of 1874, published by Munn & Co., under the heading of "Photometry of Colors," you will find a brief outlining of some crude experiments I made to determine so far as possible the relative focal length of the colors of the solar spectrum, concluding that the shorter the focal length of a color, the greater its vibratory rate. With this theory as a working hypothesis, and the idea that light travels 186,000 miles per second of time, I made an estimate of the vibratory rate of each color motion in its action upon the photographic plate, thus disclosing the descrepancies between high light vibrations and those which promoted indistinctness in the negative. By interposing a thin pale straw-colored glass between the lens and the object photographed, all colors of a high vibratory rate were reduced to greater harmony. In indoor photography, I recommended flooding the sitter with some suitable color. Still another way is to attach a pasteboard tube to the camera lens, and flood the inside with some selective color, through which the color vibrations have to pass. I have employed every shade and tint of colored glass I could get. I obtained some remarkable results with fluids for a screen. A glass receptacle made of thin white flint glass an eighth of an inch for the fluid; the receptacle wide enough and equally long to cover the lens. Transparent fluids of different chemical density give astonishingly varied results.

I was the lecturer for the National Photographic Association at the time I refer to, and I think the SCIENTIFIC AMERICAN had a reporter in attendance. At that time I made the statement that "if the principles of molecular radiation were true, the time was not far distant when we could be able to photograph the internal human anatomy." I also said that "disease as a mode of motion in some of its phases could be photographed in consequence of its action upon the epidermis." This has been done, and is done.

The striking similarity between your reproduction of Prof. Wood's experiments and several out door photos made by my experiments, elicited my attention; and although I have no copies of my work in that line at hand, I am still deeply interested in any discovery that extends the lines of scientific research. I do not know how recently Prof. Wood made these investigations, but I want you to know that an American practically covered this ground, and much more, thirty-five years ago. You may recall me as one of your contributors in an essay upon "The Fourth Dimension of Space."

Buffalo, N. Y. DR. W. M. LOCKWOOD.

Nitrogen and the Soil

To the Editor of the SCIENTIFIC AMERICAN.

In the issue of your paper dated July 1st, there appears on page 9 an article entitled "An Important Contribution to the Nitrogen Problem." This article refers to a bulletin published by Lyon and Bizzell of Cornell University, and entitled "A Heretofore Unnoted Benefit from the Growth of Legumes." I am writing now to correct an error, since the priority of this discovery belongs to the New Jersey Experiment Station. A preliminary statement of these experiments is made in the annual report of the Office of Experiment Stations, United States Department of Agriculture, for the year 1909, page 150. A copy of this report may be secured from the director of the office at Washington.

A fuller statement of these experiments was submitted to the *Journal of Agricultural Science*, published at Cambridge, England, in the summer of 1909. After much delay this paper was published in the fall of 1910. The paper in question is abstracted in the Experiment Station record for April, 1911, page 423. The inclosed copy of this paper will show you that the problem was solved in a very exact manner by a method devised at the New Jersey Experiment Station.

I should feel indebted to you for calling attention to this fact in the columns of your paper.

JACOB G. LIPMAN, Acting Director.

New Brunswick, N. J.

The Moving Picture and the Psychology of the Chauffeur

To the Editor of the SCIENTIFIC AMERICAN:

I like your comment on the article in your paper, "Psychological Apparatus for Testing Chauffeurs," and would like to suggest that the complicated signaling system could be done away with by substituting a moving-picture machine. It ought to be possible to make suitable films for the purpose, with means for throwing the recording apparatus in motion, at the instant the person to be tested sees the picture on the screen.

Jewell, Ohio. H. G. PANNING.

Testing Chauffeurs with the Moving Picture Machine

To the Editor of the SCIENTIFIC AMERICAN.

I was interested in reading Automobile Novelties. It doesn't seem to me that the signals for danger and different degrees of danger is a very fair test to the chauffeur, as he would have to be very familiar with the different signals before he could control his machine as well and as quick as he could under the conditions the signals represent or indicate. Now the moving-picture machine is perfected to such an extent, that the actual reproduction of danger can be produced in a most realistic manner, and it seems to me that by this means the test would be a far fairer one, as the chauffeur would have only his machine to think of, and in some emergencies this is a great plenty. It also seems that to put a real machine instead of the dummy would be an improvement, as it is well known that all men familiar with moving machinery of all kinds have a sense of feel that is highly developed, and would tend to put the chauffeur more at ease, as it would be more like the real thing.

Orange, Texas. F. T. RITTER.

The Knight Valveless Engine

By F. G. Sterling

IN THE usual automobile poppet valve the poppet or mushroom valves are lifted from their seats by cams and reseated by springs In a four-cycle motor, the valves in each cylinder are opened and closed once in two revolutions of the crank shaft This intermittent movement of the valve must be produced by a cam and a spring mechanism The valve is not closed until it is in actual contact with its seat Hence the valve must be free to seat itself under the action of the spring Noise is produced when the cam strikes the valve to lift it, and also when the spring strikes the seat and starts to close the valve. This noise in itself indicates a tendency to wear In the usual construction there is no way to provide for wear Furthermore, neither cam nor spring is suitable for high speed work While the poppet valves work well at low speeds, they are unreliable at high engine speeds, and the "timing," or opening and closing of the valves, is uncertain. This is the gravest objection to the poppet valve By a radical change in design, Charles Y Knight of Chicago has produced a design of valve for the four-cycle internal combustion motor, a design in which all the inherent disadvantages of the poppet valve are eliminated

For some time prior to 1908, Mr Knight manufactured and marketed in small quantities an automobile called the "Silent Knight" The claim for silence lay in the motor Although successful enough, the car, owing perhaps to lack of detailed refinement and the use of the new motor, did not appeal to the automobile trade Knight, whose chief interest was in the motor itself, thereupon took his invention to England, and succeeded in interesting the English Daimler Company in it After many tests and further development and refinement the English firm adopted it

Almost immediately the engine became the subject of much discussion and investigation by British automobile and technical societies, culminating in an exhaustive test by the Royal Automobile Club As a part of this test a 38 horse-power motor (4¾ inch bore and 5¼ inch stroke) was run continuously for 132 hours under a load of 54 horse-power The motor was then placed in a chassis and driven for 2,000 miles on the famous Brooklands track Next it was returned to the testing rack and run for five hours more and developed 57 horse-power Under the conditions of this test the load on the testing rack was never to be less than 1.3 times the calculated horse-power of the motor The road test was to be made at a speed of not less than 40 miles per hour and the final return of the engine to its bench test was to determine its final condition

These extraordinary conditions of the test were insisted upon by the Daimler Company and the final bench test was especially desired by them The reason is apparent when it is noted that the horse-power developed was in excess of the power developed at the start of the test, both tests being at the same engine speed—1,200 revolutions per minute

Evidently the Daimler Company reasoned that while it might be possible for a poppet valve engine to meet the first and second stages of the test it was obviously impossible for such a motor to meet the final stage, i e, to develop more power, to be in better condition after continued running After the motor had successfully withstood the test, the Daimler Company was awarded the Dewar trophy and the motor received the unqualified official indorsement of the Royal Automobile Club's technical committee.

Extensive tests and experiments have been made on the motor in this country, with the result that three American firms have secured licenses. In a few years the new motor will be as well known here as it is abroad.

The motor is not really valveless, nor is it in any way akin to the two-cycle motor. Knight's invention is a mechanical or structural improvement in the design of the valve mechanism.

The valve mechanism consists of two concentric sleeves sliding up and down between the piston and cylinder walls. Certain slots in these valves register with one another at proper intervals, producing large and direct openings into the combustion chamber from the exhaust and inlet ports in the cylinder The sleeves are operated by small connecting rods from a small crank shaft or eccentric shaft running at one-half the speed of the main shaft

Fig 1 shows the general arrangement of the parts and their nomenclature The detail operations of the valves can best be seen by a glance at the seven diagrams comprising Fig 2. In the diagrams the relative positions of the inner and outer sleeves at various points in the cycle of the motor are indicated The method of reciprocating the sleeves by connecting rods from the eccentric shaft is shown The eccentric shaft is positively driven, by a silent chain, from the main crank shaft and rotates at one-half the speed of the motor The eccentric operating the inner sleeve is given a certain advance or "lead" over that of the outer sleeve This lead, together with the rotation of the eccentric shaft at half the crank shaft speed, produces the cycle of operations

In the first diagram the piston is just past its top center, and is starting down on its inlet stroke The inner sleeve is at the bottom of its travel and moving slowly upward, the outer sleeve is about midway in its travel and is moving downward rapidly The opening from the carburetor through the inlet port into the cylinder is a rapidly increasing space between the upper edge of the slot in the inner sleeve and the lower edge of the slot in the outer sleeve By the time the piston is a little more than half way down on the suction stroke the inlet passage is wide open as shown in the second diagram of Fig 2. The outer sleeve is now at the bottom of its stroke and moving very slowly, the inner sleeve is gaining in speed moving upward, and the inlet is closed by the lower edge of the inner sleeve slot in passing the upper edge of the outer sleeve slot, as shown in the third diagram of Fig. 2 The inner sleeve continues to move up with the piston on its compression stroke, the rings in the head and piston tightly sealing the compression space, until the explosion occurs. The sleeves and piston are then in position shown in the fourth diagram. About two-thirds of the way down on the explosion

(Continued on page 176.)



Fig. 1.—Sectional view of a Knight sleeve-valve motor, showing arrangement of the parts.

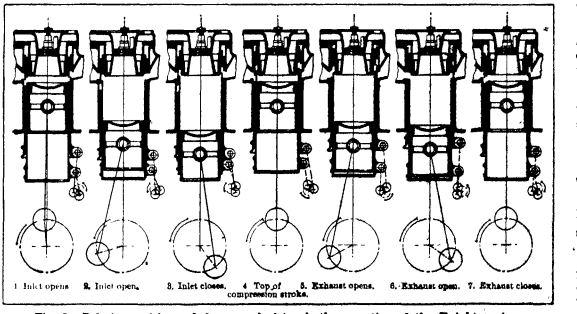


Fig. 2.—Relative positions of sleeves and piston in the operation of the Knight engine.

Abstracts from Current Periodicals

Phases of Science as Other Editors See Them

What Railroad Accidents Cost

ALTHOUGH the railroad companies take every possible precaution to avoid wrecks, the newspapers constantly report more or less serious accidents. Few of us realize what a money loss almost every one of these entails. Some figures on the wreck of the Brewster Express on the Harlem division of the New York Central and Hudson River Railroad, published in a recent number of the *Railway Employees' Magazine and Journal*, prove that any expense for prevention is economy.

That wreck occurred near Woodlawn, February 16th, 1907. Without including damages to equipment, loss owing to delayed traffic, and other things, the damage claims and other expenses paid and in process of settlement cost the road $1,214,000. Of this, $659,000 was paid in claims, and the balance was for lawyers' fees, fees to agents who settled claims out of court, physicians, investigators, and experts, and for trial suits

The largest amount paid for a single death was $75,000; the smallest $5,000. The average was $13,824 Eighteen of the twenty-two victims were women, eleven of them unmarried, which reduced materially the damages the company had to pay, though several of the single women were bread-winners.

Among the injured, the highest damages awarded were $32,500 to a young woman whose left leg was amputated This verdict has been appealed by the company Settlements for injuries have ranged from $1,000 upward.

The History of the Present Cholera Epidemic

THE following data, taken from the French publication *Larousse Mensuel*, regarding the cholera epidemic, of which we have recently felt some of the distant manifestations, may be of seasonable interest The epidemic took its origin in India in 1902, and was carried to Hedjaz by the Hindoo pilgrims on their way to the rituals at Mecca The disease was thus carried to Egypt, and in 1903 to Damascus, in 1904 to Bagdad, whence it crossed Persia and the Caspian Sea, reaching Baku and the mouth of the Volga The cholera then spread in the Caucasus (three thousand cases in Russia), and in 1905 appeared in Poland (six hundred cases), whence it entered eastern Prussia and appeared in a number of places in Germany (three hundred cases) In 1906 little was heard of the epidemic, but in 1907 it carried off thirteen thousand victims, starting from southern Russia and ascending up to St Petersburg in 1908 (thirty thousand cases) The plague continued its ravages in the domain of the Czar, and put forth a finger as far as Constantinople In 1909 a number of foci of infection appeared in Russia (twenty two thousand cases) and the disease made its appearance in several towns of Holland (sixty cases, mainly at Rotterdam) and of Belgium (nine cases), whither it was carried by ships Forty cases were also recorded in eastern Prussia Every winter the epidemic appears to die out, then it gradually resumes activity In 1910 there were 281,259 cases (131,433 deaths) in Russia, especially in the southern provinces.

This great outburst resulted in a number of isolated cases in Germany and Austria, and in numerous cases observed since the month of August in southern Italy. The disease was carried there by a number of Russian emigrants who left ship at Brindisi In this way 127 localities were infected The balance sheet for the epidemic shows 11,700 cases, with 768 deaths. In Turkey also the disease made great ravages, of which, however, no statistical records are available.

Mode of Propagation.—Inasmuch as the period of incubation of the disease lasts only six days, any healthy individual who has been out of contact with any infected person for a period exceeding six days, used to be considered innocuous, and incapable of carrying contagion. It has, however, been observed that a person may very well carry microbes in his body, and disseminate the same without being himself affected. Hence arises the necessity of examining the dejects not only of diseased but of healthy persons, as far as they may have been exposed to contagion. In Holland the rigorous application of this principle has reduced the number of fatal cases to four. While cholera may be generally contracted by contaminated drinking water, it may also be acquired through the ingestion of fruit and vegetables grown near the surface of the soil and watered with contaminated water. We may carry on our shoes and garments from the street into the houses portions of mud containing microbes, and upon brushing off such stains we distribute through the air dust and microbes which may fall upon food materials and thus enter the body

Preventive Measures.—Of these the first and the chief is naturally the strict supervision of immigrants, sailors, and similar persons That these are the carriers of the disease, and not the river water itself, is shown beyond question by the fact that the epidemic proceeds up the streams, against the current The second precaution consists in careful attention to the proper disposal of waste matter and disinfection of the same, so far as persons afflicted with the disease are concerned, and the exclusion of flies. The food and drink and medicine for the sick person should be kept carefully covered. Water and milk should be boiled before drinking, and in fact only cooked products should be eaten, which moreover should be carefully protected from access of flies Vegetables and raw fruit should be allowed to stand for half an hour in a three per cent solution of tartaric acid, and then washed with boiled water. Care should be taken not to partake of any foods (melon, unripe fruit) which irritate the intestines, so that the body may not be predisposed to offer a breeding ground for microbes.

The Motor Truck in the Country

THE *Engineering News* recently expressed the opinion that one use for the motor truck to which it would be difficult to place a limit is in direct haulage over considerable distances to safe an intermediate railway journey Direct deliveries may be made by automobile from a city wholesaler to his customers in towns twenty or thirty, or even forty, miles away at less cost, perhaps, than would be involved in the hauling to the railway station and hauling from station to receiver at the other end of the route, when the various rehandlings that are made necessary by the railway shipment are taken into account The saving in cost of packing alone, where this method of delivery is used, may often make its adoption worth while.

"There are large possibilities also in the use of motor-propelled vehicles in industrial plants, shops and warehouses in place of the industrial railway or the overhead carrier, both of which systems are in extensive use," continues the *Engineering News* "With present-day shop floors of concrete or wood-block paving, motor trucks can be run over them with little more friction than over the rails of shop tracks A great advantage over the rail system is that the trucks can be run anywhere There is no stoppage for turntables or switches or because of cars blocking the line ahead as happens so often with industrial railways In such a system, where current for charging is available at low cost and where the loads to be hauled are light, storage battery trucks appear to have great promise The extent of this one field alone is so great that it will tax the ability and enterprise of many engineers and many manufacturers to adequately cover it"

Varieties of Whales

FEW of us realize that the blue or sulphur bottom whale found in all our oceans is not only the largest animal which lives to-day, but is also, so far as is known, the largest animal which has ever existed on the earth or in its waters A writer in the *National Geographic Magazine* states that specimens have been measured which reached the length of 87 feet, and in all probability weighed as much as 75 tons Although the mouth is enormous, large enough, in fact, to permit ten or twelve men to stand upright in it, the throat measures only about 9 inches in diameter

"The finback, closely related to the blue whale, has been called the 'greyhound of the sea,' for its long, slender body is built on the lines of a racing yacht, and the animal can equal the speed of the fastest steamship. The back is dark gray, shading into beautiful light gray on the sides and pure white below. A noticeable characteristic about this whale is the symmetry of the throat coloring; the left side is dark slate and the right pure white like the under parts The baleen also, on the right side, for a distance of about 2½ feet, is white, in sharp distinction from the remaining dark plates

"The humpback is the most interesting of all our large whales, partly because of the fact that its habits are more easily studied than are those of the other members of the family Its maximum size is under 55 feet, but its body is thick and heavy, with enormous side fins, or flippers These great paddles are one-quarter the length of the entire body, and a single one from a whale 49 feet long weighed on the station scales 956 pounds The throat breast, flukes and flippers of the humpback are almost invariably covered with masses of barnacles, or rather barnacles on barnacles, for the hard, shell like Coronula are themselves the hosts of the soft pendant goose barnacles"

In Japan, the writer of the *National Geographic Magazine's* article studied the Sei whale of the Norwegians, which is the 'Iwashi kujira' (sardine whale) of the Japanese It is not a large animal, seldom exceeding 54 feet, and is formed on slender, graceful lines, much like the finback Its coloration also resembles in a general way the latter species, but it can readily be distinguished by its high, falcate dorsal fin The Sei whale has a habit of swimming just below the surface, sometimes with the dorsal fin exposed and when feeding will travel for a considerable distance in this manner It is a difficult whale to shoot, because the back is arched but slightly when the animal dives, and only a comparatively small part of its body is shown above the water at one time

It is stated that the distance traversed by whales when beneath the surface of the water depends entirely upon circumstances The longest period of submergence for finbacks, actually timed by watch, was twenty three minutes, but there is little doubt but that most large whales can remain under water a considerably longer time

Most extraordinary of all whales is the square-nosed sperm whale Instead of having plates of baleen, this whale carries a row of 20 to 25 heavy teeth on each side of the lower jaw These fit into sockets in the roof of the mouth, and assist in holding the giant squid and cuttle fish on which the enormous animal feeds Since the squid seldom gets far out of the warm currents, the sperm does not go into the cold water, but cruises about in the tropics and in the Gulf of Japan streams

In the upper portion of the head the whale has an immense oil tank in which the valuable 'spermaceti' is found in a liquid condition, and from which it may be dipped out with a bucket when an incision has been made From a sperm whale 60 feet in length which was sent to the American Museum of Natural History from Japan 20 barrels of spermaceti were taken out of the "case" and the surrounding fat This oil congeals as soon as it is cooled by the air, but the natural heat of the body keeps it in a liquid condition until the case is opened

The sperm whale is the animal which yields ambergris, the valuable substance used so extensively in the manufacture of our best perfumes Ambergris is only found in "sick" whales, that is, its presence is not normal, but is caused by a pathological condition of the intestines It has been found floating upon the water, and is also taken from the intestines themselves after the whale has died or has been killed It is used as a vehicle for perfumes, and not as an odor itself

Abolishing the Postage Stamp.

IN our day the mail traffic of large business concerns has swollen to gigantic proportions, and even the simple labor of affixing stamps requires a special clerical staff No wonder, therefore says the *Limehau*, "if the problem has been considered how the stamp could be abolished altogether without prejudice to the interests of the post office Proposals of this character have not been wanting, as for instance in Bavaria, since February 1st, 1910, large consignments are simply stamped with a postmark at the post office, the operation being carried out by machinery In this way the post office has saved the expense for paper and the printing costs for ten million stamps, while the business world has economized time and money, for affixing stamps to one thousand letters requires about an hour and a half of time

"This method of treatment, while fairly satisfactory, is still primitive We can easily imagine a much better system worked out somewhat along the lines of a gas or water meter, the letter being simply placed in a machine, and stamped with a postmark which serves at the same time as receipt for the postage and as record of the date, etc The machine would be inspected periodically by the post office in just the same way as the consumer's gas or water meter is inspected, and his bill would be paid as usual"

Lessons of the 1911 International Cup Race

Comparative Features of the Types

By Grover Cleveland Loening, B.Sc., A.M., C.E., Author of "Monoplanes and Biplanes"

THE third race for the "Grand Prix" of aeroplaning the cup and prize created by James Gordon Bennett—was held at Eastchurch, Isle of Sheppey, on the 1st of July.

The first race—that won by Curtiss in 1909 was over a distance of 20 kilometers. The following year the race, held at Belmont Park, for a distance of 100 kilometers, was won by Grahame-White. The distance this year was increased to 150 kilometers.

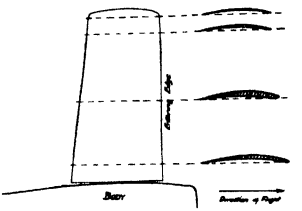
Curtiss' victory in 1909 was a splendid one, and well earned, the race of 1910 can but be described as a "fluke." Although the steady flying of Grahame-White won him much sincere praise, the unfortunate accident to Leblanc robbed him of the prize in the moment of victory.

This year's race, however, far surpasses previous contests, in the brilliancy of the flying and the highly instructive and satisfactory results given by it. The best talent of three of the greatest manufacturing concerns—the Blériot, the Wright, and the Nieuport—was set to the task of producing not only the speediest creation but one that would outwit its rivals in maneuvering and reliability. The monoplane proved itself the most adaptable type for speeding and the biplane the most easily controlled, the perfection of "banking," landing, and steady flying exhibited by the diminutive Wright, attracting much favorable comment.

The order of finishing and the official elapsed time of the contestants follow. Weymann (U. S. A.), 1 hour 11 minutes 36 1/5 seconds; Leblanc (France), 1 hour 13 minutes 40 1/5 seconds; Nieuport (France), 1 hour 14 minutes 37 3/5 seconds; Ogilvie (England), 1 hour 19 minutes 10 2/5 seconds. Chevalier and Hamel, the former on a Nieuport monoplane and the latter on a Blériot monoplane, started in the race but did not finish.

Weymann flew a Nieuport monoplane, and made an average speed of just 78.1 miles an hour. Leblanc on his Blériot later averaged 75.91 miles an hour, Nieuport on a monoplane of his own make attained an average of 74.94, while Ogilvie made 71.2 miles an hour, including time for a stop. The latter's speed of flying not considering the stop was 84 miles an hour.

Nieuport's speed was rather surprising in view of the record he made at Mourmelon on June 16th with the same 70 horse-power monoplane—100 kilometers at a rate of 80.24 miles an hour. Difference in atmospheric conditions might account for this.



Sections of the plane of the Nieuport monoplane.



Section of Plane - WRIGHT



Section of Plane - BLERIOT

Details of Planes.

The astonishingly small difference in speeds between the 30 horse-power Nieuport of Chevalier, the 70 horse-power Nieuport flown by its designer, and the 100 horse-power Nieuport of the victorious Weymann is a very noticeable fact and one deserving of the closest study.

The victory was primarily one for the Gnome motor and the French aeroplane industry in general, giving only a small insight into the enormous leadership France holds over the rest of the world in the development of the aeroplane. By no stretch of the imagination can the victory be said to be one for America except on what might be classed a technicality. Weymann not only flew a French machine equipped with a French motor but received his flying instruction in France under the tutelage of French experts.

Those who are pluming themselves on the great victory for America have therefore cause to hesitate.

May the contest of 1912 exhibit a more pronounced example of Yankee industry.

This race is the first from which concrete and valuable conclusions can be drawn, and its results point to many advantageous features that should be introduced into the next Gordon Bennett race to make it a means of stimulating greater perfection and of representing the highest achievements in aeronautical engineering.

Before pointing out important deductions obtained from a study of the machines and their performances, a brief description of each is given, accompanied by plans and elevations drawn to the same scale, thus enabling a graphic comparison to be made.

THE NIEUPORT MONOPLANE

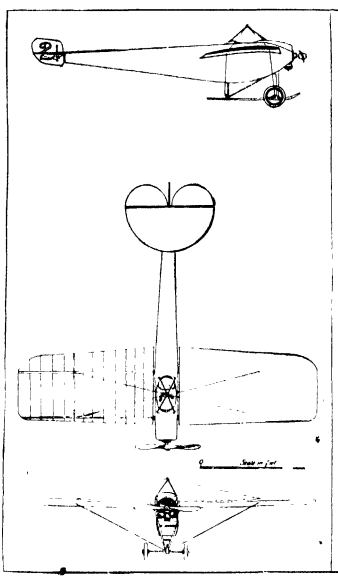
The winning machine is a distinct type, bearing little if any resemblance to the almost standard types, the Blériot or Antoinette.

The most important features in its design are the profile of the wings, the great reduction of head resistance, and the exquisite form and proportioning of the various parts.

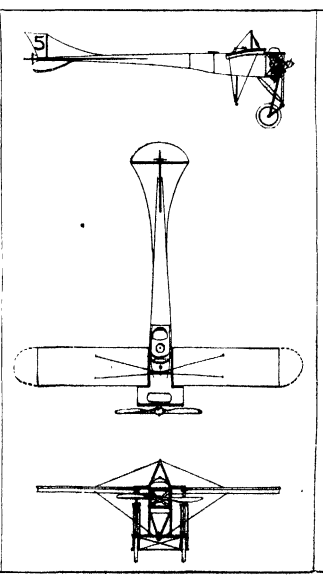
Weymann's Nieuport was equipped with a 14-cylinder, Gnome engine rated at 100 H.P. This drove at almost 1,500 R.P.M., a two-bladed Regy propeller, 7 feet in diameter.

This machine, due to its high power, appeared to the spectators to fairly leap into the air, and dart about with arrow-like swiftness and precision.

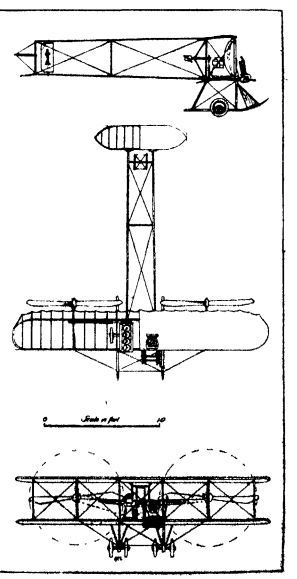
(Continued on page 176.)



The Nieuport.



The Blériot XXIII.



The Wright "Baby."

LESSONS OF THE 1911 INTERNATIONAL CUP RACE

The Satellites of Uranus

Moons That Have a Retrograde Motion

By Professor Frederic R. Honey, Trinity College

IN THE revolutions of the planets around the sun, and of the satellites around their primaries, there exists an apparent law of conformity to that general direction which is followed by our sun in its rotation on its axis But the fact that this conformity, though followed by a large portion of our discovered system, is not invariable, is emphasized by its contradiction in the retrograde motions of the ninth satellite of Saturn and of all the satellites of Uranus and Neptune. These apparent contradictions in planetary revolution have naturally given rise to much inquiry and speculation regarding the evolution of the solar system.

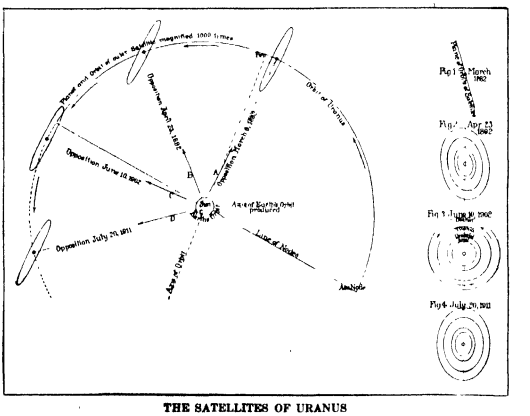
The four known satellites of Uranus, which revolve in a plane which is nearly perpendicular to that of the ecliptic, appear at their vast distance from us to have diameters varying between 500 and 1,000 miles The illustrations given in this article are for the purpose of emphasizing an example of departure from the general law of motion. The moons of Uranus, in contrast to their primary, revolve in a retrograde or backward direction—their orbital plane being just past the critical position of perpendicularity Notwithstanding the great distance of Uranus from the sun, which is more than nineteen times the earth's distance, the planet's diameter of 32,000 miles renders it visible as a star of the sixth magnitude which is of a light sea green color On account of the tilting of the earth's axis Uranus does not rise much above the horizon, and is seen to best advantage in northern latitudes during the summer months before and after opposition, which occurred this year on July 20th The period of revolution is 84 years; and as a consequence the planet comes to opposition between four and five days later each year—its synodic period (average interval between consecutive oppositions) being 369 2/3 days The plane of the orbit very nearly coincides with the ecliptic, forming an angle of only ¾ degree with it This is the smallest angle of inclination of the orbits of any of the major or terrestrial planets; while the linear eccentricity, or distance from the center of the orbit to the sun (82.5 million miles) is greater than that of any of the orbits This point is shown in the plot at C within the earth's orbit, and is about seven-eighths of the distance from the sun to the earth The angle of inclination of the plane of the satellites' orbits, which was measured in March, 1882, is less than 98 degrees The planet came to opposition on March 6th when approaching perihelion, but the plane of the orbits passed through the earth, and was seen edgewise, looking in the direction of the arrow *A*, about three weeks later, when the satellites appeared to move back and forth in a straight line (see Fig 1) The next edge view, when the plane of the orbits will again pass through the earth, will be obtained in 1924, that is after an interval of 42 years Fig 2 shows the orbits seen in the direction of the arrow *B* at the date of opposition April 23rd, 1892

During the years 1901, 1902 and 1903, the differences between the lengths of the axes of the ellipses representing the orbits on a plane perpendicular to the line of vision were so small that they were practically circular, showing the nearly perpendicular position of the orbital plane Fig 3 shows the orbits of the satellites *Ariel*, *Umbriel*, *Titania*, and *Oberon* as seen looking in the direction of the arrow *C* at the date of opposition June 10th, 1902 Since this date the minor axes of the ellipses have gradually contracted, and their positions looking in the direction of the arrow *D* on July 20th of this year are shown in Fig. 4. In each of these figures the position of the ellipses is shown relative to the meridian. These satellites revolve around Uranus (which is drawn to the same scale as the orbits) in the direction of the arrows. The distances from the planet and the periods or time of revolution are given in the table. In the plot of the orbit of Uranus the planet and the orbit of the outer satellite *Oberon* are magnified 1,000 times in order to show their relative dimensions, and the proportion between the axes of the ellipse which is the projection of the orbit on the plane of the ecliptic

	Distance in Miles	Period in Days
Ariel	120,000	2 52
Umbriel	167,000	4 14
Titania	273,000	8 71
Oberon	365,000	13 46

Treatment of Obesity

OBESITY is a disease of the general nutrition, characterized by a general hypertrophy of the adipose tissue, and an accumulation of fat in the organism "A rough rule," says *Cosmos*, "is that an adult's weight, expressed in kilograms, should be represented by the two last decimals of the figure which expresses his height in meters In a pretty severe case of obesity a person may weigh about 265 to 330 pounds. Barnum and Bailey exhibited an individual weighing 660 pounds. Heredity plays an important part in determining the occurrence of this morbid condition This has been observed both in men and in animals



THE SATELLITES OF URANUS

It is not every one who can accumulate body weight At the same time, given a certain predisposition, there are certain conditions which favor obesity, and certain modes of living and treatments which may reduce it or even cause it to disappear entirely

"Overfeeding, lack of exercise, in brief, an excess of the receipts over expenditures, favor obesity Nevertheless, there are stout people who eat very little, and there are hearty eaters who remain thin There must be some other element which enters into consideration The thyroid and certain other glands regulate all oxidation processes. The secretions of these glands intensify the oxidation, their degeneration tends to diminish oxidation The true cause of obesity is still a matter of considerable mystery Generally speaking, a special diet and mode of living is unquestionably the right remedy, and has frequently proved effective.

Some medical authors have recommended a veritable hunger cure; others impose a meat diet This last method is positively dangerous for arthritic patients, and may moreover be quite useless, since it is possible to fatten on a pure meat diet Other authorities have recommended the use of foods of low alimentary value, taken in considerable quantity, such as fruit, green vegetables, but no meat Others forbid drinking or recommend eating fat or butter in considerable quantities, thereby producing a species of satiety and destroying the appetite

"Such treatments as these are, as a rule, either harmful, or quite impossible to carry out for any length of time. A more rational treatment, it appears, has been proposed by Dr Robin, which is based on a number of seemingly well founded scientific arguments. The *régime* laid down is somewhat as follows (1) Breakfast at eight o'clock in the morning, consisting of a piece of meat, fowl, or cold ham, a small piece of bread (about fifteen grams), fresh fruit, and a cup of very weak and very hot tea, without milk and sugar, immediately after this meal take about at least half an hour's walk, but not enough to become tired or short of breath (2) At eleven o'clock the second meal, consisting of one or two boiled eggs, two pieces of bread and a cup of hot water flavored with a little tea, after this a walk as before (3) At half past twelve the third meal consisting of cold meat, cold chicken, ham *ad libitum* (without sauce or mayonnaise), a plate of green lettuce, or the like, with a little salt and lemon juice, a plate of green vegetables, boiled in salt water, without butter or gravy Fruit *ad libitum*, bread fifty grams For drink, a large cup of hot water flavored with a little tea Rise immediately after the meal and take a walk of at least half an hour (4) At half-past five, a large cup of hot water flavored with a little tea (5) At half-past seven the same meal as at noon, to which may be added, if the appetite is very keen, some cold fish, or a plate of hot meat without gravy This cure is continued until the weight is reduced, if not to normal conditions, at least to an improved state It is interrupted, if any indications appear that it is affecting the patient harmfully After the cure is terminated, the eleven o'clock meal is first of all omitted and then gradually the *régime* may be abandoned, proceeding with prudence and exercising greater rigor every time the weight is observed to increase

"It is stated that with the above treatment much improvement is secured without inflicting upon the patient any unpleasant feelings of hunger or weakness"

Cost of Building Cheops

IT HAS been estimated that to rebuild the pyramid of Cheops under modern conditions an expenditure of $100,000,000 would be necessary and the labor of 40,000 men for two years required

It has been calculated that the work really required the services of 100,000 men for thirty years

The pyramid occupies a space of twelve and three-quarter acres and is seven hundred and forty-six feet high and contains about 1¼,315,000 cubic yards of stone and granite The material alone represents an item of $36,000,000, while the labor would increase this amount by $72,000,000 To this must be added $3,000,000 for tools, transportation, and similar items

The pyramid is built on a solid rock one hundred and fifty feet deep, and to build a foundation of this character would add to the cost to the extent of making the total of $100,000,000

The Cry of the "Devil-bird"

OF all the awe-inspiring sounds emitted by wild creatures none, it is said, is to be compared to that of the "devil bird" of Ceylon, whose cry has been likened to the scream of a human being undergoing the most frightful torture Naturalists have identified this bird with the brown wood-owl found in Hindustan

The "devil-bird," or ulama, as the Cingalese call it, is an elusive creature The natives of Ceylon regard the cry of this bird with superstitious horror, for, it is claimed, its scream heard at night presages the most dire misfortunes

A British official of the Ceylon civil service has given some study to this curious bird Its ordinary note, he states, is a magnificent clear shout like that of a human being, heard at a great distance, and producing a fine effect in the silence of the night But the sounds that have earned for the bird its bad name, and which this officer reports he heard to perfection but once, are said to be well nigh indescribable the most appalling that can be imagined, and scarcely to be heard without a shudder It has been compared to the cries of a boy in torture, whose screams are being stopped by strangulation.



[The Editor of the Home Laboratory will be glad to receive any suggestions for this department and will pay for them, promptly, if available.]

Etching Metals by Electricity

By A. J. Jarman

THE etching of metals by electrical energy does not seem to have received the attention it deserves It must be borne in mind that wherever any chemical body is employed to perform etching, there also is electrical action

Many times when etching by electricity has been attempted, the protective top bearing the inscription has been eaten away before any appreciable depth has been attained This has been caused by the employment of an unsuitable etching fluid, or the protective top was not sufficiently resistant to the separated element or ion liberated by the electric energy By a little study of the chemical bodies employed for etching either copper, zinc or steel, such as nitric acid, perchloride of iron, sulphate of zinc, and chromic acid, it has been found that these bodies are not the best suited for electrical etching The real point to be considered is the effect of the liberated element upon the metal Several solutions have been found that will answer the purpose well, and it is safe to predict that in due time the etching of metals by electric energy will become universal, because by the employment of electricity, it can be as readily ascertained how far the etching has proceeded by noting the amperage and the time elapsed, or, in other words, *quantity* of electricity employed This, according to Faraday's law, is proportional to the quantity of metal dissolved By the *electrolytic* method one man could perform all the etching of six plates in the same time that it takes to etch one by the usual processes For the protective top, any of the preparations may be used that are employed at present for ordinary etching, such as albumen, fish glue, enamel or bitumen.

For the information of those who are not acquainted with the above preparations it may be stated that the following will give results that can be depended upon, bearing in mind that where water is mentioned, *distilled* water is meant at all times

SENSITIZING SOLUTION FOR ZINC

The white of one fresh egg (albumen)	
Distilled water	6 ounces
Bichromate of ammonia	20 grains

Dissolve the bichromate of ammonia in two ounces of the distilled water The remaining four ounces of water must be added to the albumen, which must now be well churned into a frothy mass for two or three minutes Add two *drops of strong* aqueous ammonia to the egg mixture, using the egg beater, then add the bichromate mixture, beat again well, add half an ounce of pure photographic alcohol, using the egg beater again, so as to insure perfect incorporation After the bichromate has been added to the albumen, the mixture becomes sensitive to light, and therefore all subsequent steps should be carried out in red light, or at any rate in subdued daylight Allow the mixture to stand over night, then filter it through a tuft of absorbent cotton pressed lightly into the neck of a clean glass funnel, placing a flat strip of glass into a wide mouth bottle diagonally under the tip of the funnel, so that the sensitive albumen mixture falls drop by drop upon the glass strip The object of this is to prevent the forming of air bubbles The filtering must be conducted under a deep orange colored light

If copper or steel is to be employed, the following mixture must be made

SENSITIZING SOLUTION FOR COPPER

Photo-engraver's fish glue	2½ ounces
Water	2½ ounces
Albumen (fresh)	¼ ounce
Bichromate of ammonia	50 grains
Water	½ ounce

Dissolve the bichromate separately add this to the fish glue and albumen The mixture must now be well churned by a rotary egg whisk or beater, then filtered as described for the zinc sensitizer, but preferably twice The etching solution must be made up, and kept in a glass battery jar The etching solution given here is a special mixture for *electrical* etching only

ETCHING SOLUTION.

A saturated solution of common salt, about	2 pints
Hydrochloric acid	2 fluid drachms
Water	5 ounces

This solution will keep well. The use of hydrochloric acid is to correct for the liberated sodium hydroxide which is formed by electrolysis; the liberated chlorine performs the etching, and combines with the zinc or copper, forming chloride of zinc or chloride of copper In the case of steel, perchloride of iron is formed. Each metal must be etched in a separate solution. It will be observed that, after etching, the solution for zinc will remain white, that for copper will turn green, and the solution for steel will become a brilliant yellow To perform the etching, an ordinary half-tone negative (reversed) must be employed, or for line etching an ordinary dense line negative, made by the wet collodion process

Procure a few pieces of zinc plate about one-sixteenth of an inch thick, the same as used by photo-engravers Carefully clean the plate by wiping it all over, back and front, with a warm solution of common washing soda Rinse the plate in clean water, and allow to dry This operation is simply to rid the surface of any greasy matter introduced by handling The plate

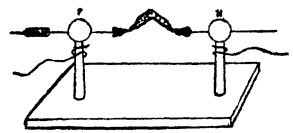


Fig. 1.—Electric etching in line on zinc.

First arc lamp, Sir Humphry Davy, 1808 From an old engraving, 1812.

must now be cleaned thoroughly, with fine pumice powder and water, by placing it face up upon a clean board, using a clean rag dipped into the pumice powder, and rubbing well up and down, not in circles. The plate must be reversed, so that the bottom end becomes the top, and the rubbing continued until, when washed with water from a faucet, the water will remain free and even all over, showing no greasy streaks or spots Now drain the plate after it is well washed in running water all over, and pour a small quantity of the sensitized albumen mixture (under an orange light) upon one end of the plate.



Fig. 2.—Michael Faraday.

Halftone electric etching on copper. From an old photograph.

Tilt it so that the water is driven before the albumen, and allowed to run off Drain the plate; then pour a small quantity of the sensitive mixture upon the opposite end and drain this off, allowing only a small quantity to remain upon the plate, which must now be gripped tightly at one corner by a pair of flat-nose pliers, and held level over the flame of an alcohol lamp, or small gas stove. Blow upon the surface with the breath, so as to aid evaporation of the water. Care must be taken that the plate does not become too hot, because this would cause the albumen to become insoluble. The plate now being dry, may be laid upon the negative, which has previously been placed in a photographic printing frame A piece of felt is placed upon the back of the zinc plate, the back adjusted, and the springs, which should be very stiff, hitched into place. The negative must be allowed to rest upon a stout piece of flat glass in the printing frame The frame can now be placed in the sunlight. If this is very bright, and the negative is a clear and brilliant one, the exposure will be about one minute and a half to two minutes The frame must now be returned to a room illuminated by a deep orange colored light, the zinc plate removed, laid back down upon a stout sheet of glass, and a small India rubber roller, which has been carefully rolled up with a small quantity of lithographic ink, is passed over the printed surface of the zinc, rolling from front to back. The plate may now be reversed, and rolled until the surface presents a uniform gray coating of ink all over Now place the inked plate into a tray of clean water, let it remain for five minutes, then take a tuft of wetted absorbent cotton, and carefully wipe the inked surface still under the water, when, if the exposure has been right, a beautiful print in minute dots or lines will present itself upon the surface of the zinc The plate must now be removed, washed under the faucet, and carefully dried, then powdered all over with dragon's blood, the excess being removed by tapping the back with a sharp blow of a hammer handle, holding hammer head in the hand. The surface must now be lightly brushed with a flat camel's hair brush and the plate heated over a gas flame, until it begins to smoke faintly Then lay it upon a piece of cold metal for about two minutes, when it will be ready for the etching bath Two cells of the zinc and kind described in the SCIENTIFIC AMERICAN of May 28th, 1910, page 445, will form the battery for generating the requisite electrical energy

The elements must be coupled in series, viz., the carbon of one cell connected by a piece of copper wire to the zinc of the next A piece of sheet copper, zinc, or brass must be soldered to a copper wire and attached to the zinc cylinder of the free element. This will form the cathode It must be remembered that electrical etching is the reverse of electroplating

The piece of zinc bearing the ink image must be brushed over every part that is not to be etched, with either shellac varnish or a thin coating of asphaltum varnish, which is best done when the plate is warm This protection will prevent the plate from being attacked, except where the required etching is to take place The plate must now be attached to the remaining carbon element of the battery, by simply soldering a tin or brass garter clip to the end of a strip of copper wire, the right kind of clip being one of those with saw-like teeth This will grip the plate perfectly, and allow easy removal The plate, now being firmly gripped, must be quickly lowered into the salt solution Instantly gas will be evolved from the cathode, while the metal exposed between the dots will begin to dissolve After two minutes' action the plate should be lifted and examined, when in nine cases out of ten it will be found to be satisfactory Dip the plate into the liquid again for three minutes, then remove it, and pour a gentle stream of clean, cold water over the surface Now use a biconvex lens of about four inch focus to examine the surface, when it will be found that for all ordinary printing purposes, the etching will be deep enough

The albumen top will hold well in this etching solution, because it is well known that albumen becomes coagulated in a strong solution of common salt If upon examination it is found that the etching is not deep enough, the plate should be very carefully brushed all over the surface with a flat camel's hair brush; then washed, dried and the ink roller carefully passed over the surface again, then warmed to partly set the ink, powdered again with dragon's blood, heated to melt this again, cooled off, and etched again for two or three minutes As a rule, this second etching is not required. The surface must *not* be rubbed with absorbent cotton, because the edges of the etch are very sharp, and the fiber of the cotton will adhere very tenaciously The plate may now be cleaned with either wood alcohol and ammonia, or if asphaltum has been used, benzine or turpentine must be employed to remove it When the plate is cleaned, it can be trimmed at the edges, and pinned to a wooden block to make it type high, fitted in with type in the usual way, inked up and printed. If the etching is to be done upon copper, the fish glue enamel must be used, because it is better suited for copper than the albumen resist. Procure a piece of sheet copper the same as used by photo-engravers, that has been faced, polished and buffed. Clean it in the same way as described for zinc. Use

(Continued on page 177.)

The Inventor's Department

Simple Patent Law; Patent Office News; Inventions New and Interesting

Electrified Artificial Rain for Agriculture

A New System of Irrigation

WE have had occasion in these columns to refer repeatedly to experiments carried on by Sir Oliver Lodge and others on the influence of electricity on the growth of plants. Mr. Emilio Olsson of Buenos Aires, Argentine Republic, at present in the United States, has, of late years, been giving his attention to the practical development of a process in which it is proposed to make use of electrified water for sprinkling fields. The inventor claims that his experiments demonstrate the practical utility of such a procedure. The benefits which are said to be secured are two-fold. First, there is a direct advantage to the plants, and secondly, Mr. Olsson states that according to his observations various harmful insects and other organisms are destroyed because of his process.

The need of artificial irrigation is severely felt in many places where, owing to the nature of the climate, long terms of drought have to be contended with. It is particularly in such districts as these that Mr. Olsson proposes to introduce his system, by the aid of which he expects to increase the crop and to combat effectually drought, insects and other troubles. The cost of the Olsson system is estimated at a figure which is quite moderate as compared with the benefits to be derived. The cost of installation for the sprinkling apparatus is figured at $50 to $100 per acre, according to local conditions.

The system is very simple. The water is raised to a suitable height by a motor or traction engine. The supply may be drawn from a river, stream, artesian well, or any other suitable source. Two high towers may be installed, from which pipes are suspended by means of suitable supporting cables. The pipes supply circular spray nozzles which revolve automatically, and five to ten acres of land can readily be thus supplied with an evenly distributed shower of water.

When it is desired to use electrified water, a reservoir is used, into which the water is pumped, to be subsequently distributed in the manner indicated above. The reservoir consists of an iron tank placed on an insulated support and charged from a dynamo supplying 0.5 ampere at 110 volts. The iron wall of the tank serves as positive pole, the negative pole consists of a copper wire insulated all except the tip. It is claimed that certain chemical reactions take place in the water, with production of oxygen, ozone, and hydrogen peroxide at the anode, and that certain of the products formed are beneficial to the plants. Mr. Olsson further suggests that this electrification of the water would tend to purify it and render it better adapted for drinking purposes.

Mr. Olsson has installed his apparatus in a plantation near Buenos Aires and states that by the use of six sprinkling nozzles at a height of 5 meters above ground some six hundred acres of ground under cultivation were treated with very beneficial results. The apparatus has also been adopted by the municipality of Buenos Aires and is giving satisfaction in the public parks and gardens in that city. Mr. Olsson also states that during the long drought from which the republic suffered for over six months in 1910, he was able to produce a very fine crop of alfalfa and vegetables and to supply the owners of race horses with fresh fodder. By installing a system of artificial irrigation over some part of their crop, farmers should be able to insure themselves against drought, falling back upon artificial sprinkling in case natural rain fails.

Incidentally the interesting suggestion is made that the water line be used at the same time to carry the current for lighting and other purposes.

Mr. Olsson's invention has been protected by a number of patents, and the inventor has shown much perseverance in working out the details of his method.

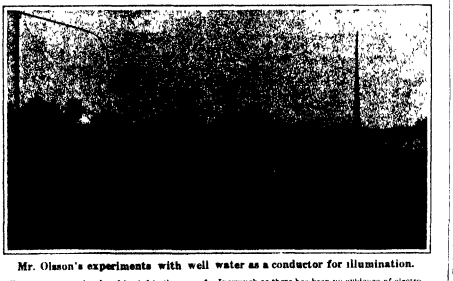
Swedish Milking Machine

A MILKING machine has been developed in Sweden which imitates the process of hand milking as nearly as possible, that is by compressing the teat *from top to bottom*, but without drawing down upon it. Each teat enters a small metal box in which is a fixed rubber plate lying along one side of the box, while a movable rubber sheet is driven forward by two pistons, lying one above the other, so that the pressure is made first by the top piston and then by the bottom one, as in hand milking, or ten such machines for milking one hundred cows in two hours, where seven or eight milkers would be needed for hand milking. The animals do not seem to object to the machine and keep quiet during the operation.



Irrigation by means of electrified artificial rain.

In this new application of electricity, plant growth is stimulated by electrified water.



Mr. Olsson's experiments with well water as a conductor for illumination.

The pipes are insulated and buried in the ground. Inasmuch as there has been no evidence of electrolysis, Mr. Olsson believes that the electrolytic destruction of water pipes may thus be prevented.

After this, the pistons are thrown off by an automatic device and the process begins again. A funnel-shaped rubber bag takes the milk and it flows from here into a containing vessel of suitable shape. There is one front and one rear milking box and these are held in a forked support which is strapped to the animal. The rubber plates and bag are the only parts to come in contact with the milk and these can be very easily cleaned, so that there is no difficulty about this part. Any kind of an air compressor is used to operate the pistons and it is driven by electric motor or gasoline engine or even by horse drive. The air pipes are led along the stables and at each stall is a fitting upon which a rubber tube leading to the milker is placed. Two milkers can take care of eight

Notes for Inventors

An Automatic Elevator-door Lock.—The Otis Elevator Company, as assignee of Axel Magnuson of New York city, has obtained a patent for operating apparatus for the locks of elevator doors, No. 998,624. The latch is associated with the door and its operating device is separate from and independent of the car and is automatically operated only when the car is opposite or near the door.

Westinghouse Turbine Patents.—George Westinghouse of Pittsburg has obtained patent No. 998,820 for turbine-blading, and No. 998,821 for a condensing-turbine.

The turbine-blading includes in connection with the rotor having annular rows of blades, the stator, the blade carrying elements and circumferentially extending rows of stationary blades on the elements, the elements being mountable on the stator. The condensing-turbine is a re-entrant turbine in which the casing is divided into a stationary part and a cover and the fluid discharge devices are located entirely in the stationary part.

Coin-handling Machinery.—In a coin-handling machine, patented No. 998,830, to Universal Coin Wrapping Machine Company of New Jersey, as assignee of Chas. S. Batdorf of Brooklyn, is provided means for adjusting the coin-advancing and coin-wrapping mechanism to agree with the size of the coins to be wrapped and with the length of the packages.

A Peculiar Laminated Propeller.—Spencer Heath of Washington, D. C., has patented No. 998,897, a bladed propeller, consisting of interior laminations of soft wood and exterior lamination of hard wood, with hard wood portions forming the extremities of the interior laminations.

Hair Washing Hoods.—Most women resent the difficulties and inconveniences incident to the washing of the hair by the ordinary processes. Orlando B. Salisbury of New York city has obtained two patents, Nos. 998,803 and 998,804, for hair-washing hoods. He provides a hood to fit the head and neck sufficiently large to inclose the hair and supplied with suitable means to admit and discharge the water and lathering, on its interior, flexible fingers, which may be manipulated from the outside to aid in the washing operation.

An Old Patent on Cooling Houses.—Now that the subject of cooling dwelling houses in hot weather has attracted general attention largely through the ingenious efforts in that direction of Dr. Alexander Graham Bell at his Washington residence, it may be worth while to call attention to a patent, No. 246,781, issued in September, 1881, and now expired, to R. S. Jennings of Baltimore, Md., for an air-cooling apparatus which provided a cooling chamber having screens of fibrous materials arranged longitudinally and vertically and which, in practice, were moistened with a cooling liquid. The apparatus presented in this patent has a special interest since it was used in cooling the White House during the hot period when the wounded President Garfield lay suffering from the assassin's bullet, and the descriptive portion of the patent refers to "the use of the hereinbefore described apparatus at the Executive Mansion, Washington, District of Columbia."

Patents to Corporations.—Among the patents issued July 25th, 1911 are five patents and one reissue to the United Shoe Machinery Company, and eight patents to the General Electric Company.

A Negro Patent Examiner.—Henry E. Baker of Mississippi is the only representative of the colored race in the examining corps of the United States Patent Office. Mr. Baker is a second assistant examiner in the division of Principal Examiner Pond, who has the classes of bridges, hoisting, excavating, hydraulic engineering and metallic building structures, which includes, of course, structural iron working, and all allied arts. Mr. Baker, in addition to his duties in the Patent Office, is engaged in the compilation of a work in which he will be absolutely unique. He is the only individual who has a complete list of all the patent issued to negroes, and it is his purpose to embody them into a work of some sort probably a book, giving a brief history of each inventor, the nature of the invention and the amount of success in the field of invention achieved by members of his race. The compilation of these statistics has necessarily been an arduous one, and has required an exhaustive correspondence with applicants and inventors in all parts of the globe. Naturally, many colored inventors fail to offer any evidence as to the race to which they belong as that is not a requirement made of an applicant for patent. But through the courtesy of attorneys and the aid of his fellow examiners Mr. Baker has been able to gather together what he considers is practically a complete catalogue of inventions by colored persons.

Billings Lectures on Patent Law.—The Hon. Cornelius C. Billing, First Assistant Commissioner of Patents, has accepted the invitation of the president of the Washington College of Law to deliver a series of lectures on Patent Office practice, before the classes of that college. Mr.

Billings is thoroughly conversant with every phase of procedure within the Patent Office. He commenced his career in the capacity of assistant examiner and has occupied every position in the office at one time or another. He became principal examiner by due course of advancement, was law examiner, examiner of interferences, acting examiner of trade-marks and designs, and a member of the board of examiners-in-chief. The present commissioner selected him for the position of assistant commissioner, and when the office of first assistant commissioner was created by Congress to meet the growing demands of the judicial branch of the office, Mr. Billings received the appointment. During the absence of Commissioner Moore in South America for four months in 1910, Mr. Billings was acting commissioner, so that the statement that he has filled every office in the Patent Office is specifically true.

Considering the duties which he discharges in his present place, in the hearing and deciding of appeals in patent cases, which decisions are final so far as the Patent Office is concerned, there is no doubt that his course of lectures at the Washington College of Law will be of the greatest interest and value.

A Commission for Supervision of Patents.—The Minnesota Electrical Association and the St. Louis section of the American Institute of Electrical Engineers have adopted resolutions petitioning President Taft to urge in his message to Congress the establishment of a permanent commission or department of the government for the supervision of patents and similar properties. It is thought that the functions of the Patent Office, as at present organized, stop short of that point where they could be of the greatest value to inventors, owners of patents and stockholders all over the country. The Patent Office has no control over patents after they are granted, and the electrical organizations named above, while recommending the establishment of a commission to supervise patents, trade-marks, etc., do not contemplate the robbing of the Patent Office of any of its existing functions. Rather there is a desire to increase those powers. Whether or not such a commission would savor of paternalism, it cannot be denied, but if, as contemplated, it should exercise a power somewhat similar to those of the Interstate Commerce Commission, much good might be accomplished in the business world. The preservation of the rights of inventors, manufacturers and investors through a supervisory board or commission would in all likelihood be preventive of fraud and infringement to a large degree.

Phonographic Advertising.—An advertising device, having an advertiser exhibitor and a phonograph to announce the advertisement as it is displayed, is shown in a patent, No. 998,721, to George A. Stafford of Belchertville, Texas. It has a motor which, through suitable mechanism, operates to display advertisements successively and the motor also operates the phonograph to announce the advertisements.

Putting Out Gasoline Fires.—In our issue of July 15th, we stated that there was not yet a fire extinguisher especially adapted to put out fires "accompanied by the burning of gasoline or resultant gases." A manufacturer calls to our attention his own product which is widely advertised, and which consists in excluding oxygen and preventing combustion. His is what he calls the "gas blanket" principle, applicable to all kinds of fires, even those of electrical origin. The substance which he uses is an absolute non-conductor with a dielectric strength of 500,000 volts per cubic inch.

Legal Notes

The Chartreuse Liqueur Case.—The Supreme Court in an opinion delivered by Mr. Justice Hughes, has confirmed the right of the Charthusian monks in the well-known trade-mark for liqueur or cordial. In reciting the facts, so far as the Court deemed it necessary to state them, the decision says that:

For several hundred years prior to 1903—save for a comparatively brief period following the French Revolution—the order of Carthusian monks occupied the monastery of La Grande Chartreuse near Voiron, in the Department of Isere, in France. This was their Mother House. There, by a secret process, they made the liqueur or cordial which, at first sold locally, became upwards of fifty years ago the subject of an extensive trade and is known throughout the world as Chartreuse. The monks originally manufactured the liqueur at the period following the French Revolution—the order of Carthusian monks occupied the monastery of La Grande Chartreuse near Voiron, in the Department of Isere, in France. This was their Mother House. There, by a secret process, they made the liqueur or cordial which, at first sold locally, became upwards of fifty years ago the subject of an extensive trade and is known throughout the world as Chartreuse. The monks originally manufactured the liqueur at the period following the French Revolution, when they were driven out and later at Fourvoirie, close by. It was marketed here and abroad, in bottles of distinctive shape, to which were attached labels bearing the inscription "Liqueur Fabriquee a la Cde. Chartreuse," with a facsimile of the signature of L. Garnier, a former Procureur of the order, and its insignia, a globe, cross and seven stars, and these symbols, which "Cde Chartreuse" underneath, were also ground into the glass. In 1878, the then Procureur registered two trade-marks in the Patent Office, and these were re-registered in 1884 under the act of 1881. In the accompanying statement the one was said to consist "of the word 'Chartreuse,' accompanied by a facsimile of the signature of L. Garnier," and the other "of the word-symbol 'Chartreuse' and the combinations in which these were used were described."

In the year 1903, having been refused authorization under the French law of July 1st, 1901, known as the Associations Act, the congregation of the Chartreux was held to be dissolved by operation of law, and the monks took steps to their properties in France by a "sequestrating administrator and liquidator," appointed by the French Court. Forcibly ejected from their former establishment, and taking their secret with them, the monks set up a factory at Tarragona, in Spain, and there, according to their ancient process, they have continued the manufacture of the liqueur, importing from France such herbs as were needed for the purpose.

The French liquidator, Henry Lecouturier, employing a skilled distiller and chemical assistants, undertook, by experimentation, to make at Fourvoirie a liqueur, either identical with, or resembling as closely as possible, the famous "Chartreuse" and having succeeded in this effort to his satisfaction, he placed his product upon the market under the name.

The liquidator's cordial was shipped to this country and sold by the agents of the liquidator the same description and with the same marks and symbols which had been used by the monks, if there was any difference, it is frankly stated to have been unintentional.

On final hearing the Circuit Court held that the registered marks constituted good and valid trade marks and the sole and exclusive property of the Charthusian monks or fathers. The Circuit Court of Appeals affirmed the decree with some modifications which affect only the paragraph containing the injunction.

In considering the argument that the mark is a geographical name, Justice Hughes says:

If it be assumed that the monks took their name from the region in which they settled in the eleventh century, it still remains true that it became peculiarly their designation. And the word "Chartreuse" as applied to the liqueur, which for generations they made and sold cannot be regarded in a descriptive sense as a geographical name. It had exclusive reference to the fact that it was the liqueur made by the Carthusian monks at their monastery. So far as it embraced the notion of place, the description was not of district, but of the monastery of the order—the abode of the monks—and the term, in its entirety, pointed to production by the monks.

In considering the effect upon the U. S. trade-mark rights of the liquidation proceedings in France, the decision, after referring to certain House of Lords and Court of Appeals proceedings in the related case in England, says:

If through his experiments, the liquidator had not succeeded in making a liqueur which resembled that of the monks, he would have had no business to transact so far as the liqueur was concerned, and the transfer by operation of law would not have availed to give him one. But the property in the trade-marks in this country did not depend upon the success of the endeavors of the liquidator's experts. The monks were enabled to continue their business abroad, and still had the process and, continuing it, they enjoyed all the rights pertaining to it save to the extent to which by force of the local law they were deprived of that enjoyment in France.

The decision has a special interest in its bearing upon so-called geographical marks, for, after citing Canal Company v. Clark, 13 Wall. pg. 324, Columbia Mill Company v. Alcorn, 150 U. S. 460; Elgin National Watch Company v. Illinois Watch Company, 179 U. S. 665, the Court says:

"The familiar principle, however, is not applicable here," and points out that "so far as it embraced the notion of place, the description was not of a district, but of the monastery of the order; the abode of the monks—and the term in its entirety pointed to production by the monks."

Recently Adjudicated Patents.—Out of ten adjudicated patents reported in the Patent Office *Gazette* of July 25th, 1911, eight patents were sustained by the courts, and infringement was found in four cases. One of these was in the case of the Gillette razor patent, No. 775,134, in Gillette Safety Razor Company v. Clark Blade & Razor Company (C. C.) 187 Fed. Rep. 149.

RECENTLY PATENTED INVENTIONS.

These columns are open to all patentees. The notices are inserted by special arrangement with the inventors. Terms on application to the Advertising Department of the SCIENTIFIC AMERICAN.

Pertaining to Apparel.

GARMENT.—S. TREBEL, New York, N. Y. This garment is for use for bathing, athletic and other purposes, and is provided with an integral jockstrap, which can be conveniently opened and closed and when worn is practically concealed and not visible. For the purpose mentioned use is made of a suspensory band extending from the back of the garment and having its free end detachably connected with the free ends of straps or webbings attached to the rear of the garment.

Electrical Devices.

ELECTRIC BRAKE.—W. F. MOODY, Denver, Colo. This brake is of the kind provided with a flexible brake band. The invention provides in connection with the band a rocking member whose ends are connected with the ends of the brake band and braking force is applied to its middle portion, so that when the brake is set the position of the rocking member is changed by the tension of the brake band; one end of the rocking member acts for the moment as a fixed pivot and the opposite end pulls upon the opposite end of the brake band, so that the rocking member operates as a lever of the third class, and applies braking force effectively, with least expenditure of force.

Of General Interest.

DECK LASHING DEVICE FOR LIFE SAVING APPLIANCES.—F. EIRKEEN, 3 Tuffel bays Alle, Copenhagen, Denmark. This device is for the lashing of life-saving appliances, such as life-boats and the like, well lashed to the deck, so as not to be swept overboard in a heavy sea, are so much the more difficult to release and it takes a longer time to do so the greater the firmness with which they are lashed to the deck. The invention has for its object the device that the boat or raft is safely fastened to the deck, but released automatically if the ship sinks, whereby the boat or raft floats.

CABLE CLAMP.—C. A. BUTLER, Bartlesville, Okla. This invention provides a clamp for quickly and readily attaching a releasing cable, provides removable jaws and special gripping jaws for varied employments, the jaws being universal for mounting in the clamp, provides jaws arranged for a multiplicity of adjustments to accommodate the use in conjunction with tables constructed of different materials, and provides an apparatus having an auxiliary clamp and holding device for the second line or cable.

ROCK LOOSENING AND IMPREGNATING DEVICE.—P. TRIPKE, Dortmund, Germany. This invention consists of a device adapted to tamp a bore-hole made in any rock or coal-stratum and to force any quantity of water pressure from an end portion of the bore-hole through the faults and crevices in the rock or coal stratum for bringing down or loosening the rock, while the water is prevented from escaping directly through the bore-hole to without.

FEED MEASURING APPARATUS.—J. J. SMITH, West Hoboken, N. J. The purpose here is to insure accuracy and economy in feeding stock, and to enable the quantity to be varied at any instant, yet made always definite and certain, so that on those days when draft animals are working a full feed for the day may be readily measured, while on Sundays or other days of rest a smaller feed may be measured with equal certainty and with the same facility.

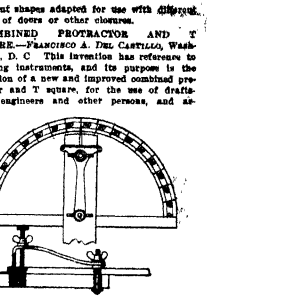
WHISTLE.—A. W. PROCTOR, New York, N. Y. This invention relates especially to whistles of the kind used as toys, the more particular purpose being to give the whistle such form as to facilitate its being held in position by aid of the lips and teeth of the operator. Further it relates to means whereby the sound may be so modified as to simulate the throbbing call of a bird, the throbbing to some extent under direct control of the operator.

PHOTO ENGRAVING DEVICE.—G. A. LEBEAU and H. R. THERESER, Nashville, Tenn. An object here is to provide means whereby a negative having a better detail may be produced. A further object is to provide means for obtaining good strong solid dots in the blacks of the negative in a minimum of time. The device is simple in its nature and inexpensive.

Hardware and Tools.

LOCK.—RAFFAELE PERLA, 2 East 120th Street, New York, N. Y. The object of this invention is to provide a lock which serves the purposes of the ordinary padlock, which, when in position, prevents the staples or eye-bolts from being filed or cut, and which renders difficult other unauthorized methods of opening the lock. His further object is to provide a lock in which the lock bolt proper is operated by key-controllable mechanism of the pin-tumbler type, which permits of a large number of vibrations on the key-controllable mechanism, and which may have the casing of different shapes adapted for use with different kinds of doors or other closures.

COMBINED PROTRACTOR AND T SQUARE.—FRANCISCO A. DEL CASTILLO, Washington, D. C. This invention has reference to drafting instruments, and its purpose is the provision of a new and improved combined protractor and T square, for the use of draftsmen, engineers and other persons, and arranged to permit of setting the blade of the square to any desired angle indicated by the protractor or to accurately fasten the blade in right-angle position relative to the base of the protractor. For the purpose mentioned in the foregoing use is made of a protractor (illustrated herewith), at the center of which is pivoted a blade, and an arm extends from the pivot of the blade and is provided with spaced pins straddling the sides of the blade, the pins also engaging apertures in the protractor.

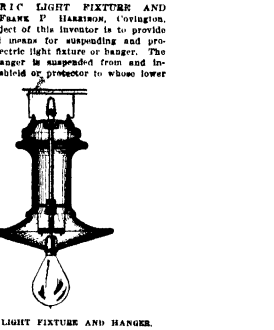


COMBINED PROTRACTOR AND T SQUARE.

Heating and Lighting.

ACETYLENE GAS GENERATOR.—L. E. BOSTROM, Ormond, Fla. The object of the invention is to provide a simple and efficient feeding device for acetylene gas generators, by means of which the carbid will be fed in small amounts to the generator whenever the pressure in the generator falls below a predetermined level.

ELECTRIC LIGHT FIXTURE AND HANGER.—FRANK P. HARRISON, Covington, Ga. The object of this inventor is to provide an improved means for suspending and protecting an electric light fixture or hanger. The fixture or hanger is suspended from and inclosed by a shield or protector to whose lower portion a lamp socket and a reflector may be conveniently attached. The details of construction, arrangement and combination of parts are illustrated in the accompanying engraving which represents a central vertical section of a lamp fixture and hanger constructed in accordance with the invention. The several parts of the interior portion are easily detachable from one another, which facilitates storage and transportation.



ELECTRIC LIGHT FIXTURE AND HANGER.

Household Utilities.

ATTACHMENT FOR INVALID BEDS.—JOSEPHINE M. SWANSON and T. S. OLSEN, New York, N. Y. The object here is to provide a bed which is inexpensive and simple, and which may be used as a foot rest or a seat to support the patient when the bed is raised, and the patient in an inclined position; as a back rest; as a table, as a protector to prevent an unconscious or delirious person from injuring himself against the head of the bed; and as a cradle for supporting the weight of the bed clothes.

Machines and Mechanical Devices.

UNIVERSAL RUDDER FOR FLYING MACHINES.—W. KRIMOWA and W. BOUSSON, New York, N. Y. The more particular purpose here is to provide a rudder for service upon flying machines; that is to say, a rudder having a vertical movement for controlling altitude and a horizontal movement for controlling direction relative to the points of the compass—the rudder having surfaces disposed at different angles for assisting movements of the rudder to be effected.

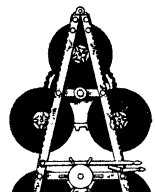
SEWING MACHINE.—J. L. KRAKOWSKY, New York, N. Y. In this instance use is made

of a thread case adapted to contain a spool of thread and a loop-taking hook mounted to oscillate on the peripheral face of the case to take hold of the needle thread loop and to carry the loop sufficiently far around the case for finally casing of the loop to form a lock stitch in conjunction with the spool thread

TRIP MECHANISM FOR WELL SINKING MACHINES.—H. H. HAIGHT, Winnebago, Minn. This invention provides a mechanism for use in conjunction with the jerk line or drop cable used in a well sinking machine, provides a pulley for the said cable arranged to regulate the extent of the take-up of the cable, and provides a construction for the pulley and mounting therefor which is durable, simple and efficient.

DRIVING GEAR.—J. L. KLEINMAN, New York, N. Y. In this patent the invention has reference to pedal-actuated driving mechanisms, and the object is to provide a new and improved driving gear more especially designed for use on sewing machines and the like, and arranged to convert the oscillating motion of the pedal into rotary motion without undue exertion on the part of the operator.

BELT RACK.—ROBERT L. SMITH, Ninth and M Streets, Lincoln, Neb. The belt rack illustrated herewith in an end elevation occupies little room and carries many belts which may be readily moved to the desired position to permit of being unrolled. The device is constructed so that the belting is prevented from slipping from the spindles by the frame of the



BELT RACK.

device, it being possible to move the spindles to a position at which the belts can be readily moved. Means provide for locking the operating parts so that the spindles with belting may be held on a predetermined position relatively to the frame. Means provide for retarding rotation of the spindles carrying the belts. Also means by which rolls of belting may be wedged there around.

Prime Movers and Their Accessories.

PACKING.—P. S. TIRRILL, deceased; MAUD M. HEATH, Administratrix, care of Heath-Clark Co., Lyndonville, Vt. The object in this invention is to provide a packing, especially adapted for use with turbine engines, to prevent the escape of steam around the shaft, and also to prevent the entrance of air when the first stage pressure is below the atmospheric pressure, and which will not require any great amount of skill to fit, and when in place will not injure the shaft by cutting

STEAM TURBINE.—J. BLAKSLEE, New York, N. Y. An object here is to provide a turbine with a rotor, to which the steam is admitted at the periphery and exhausted at the center, the rotor comprising a plurality of stages having gradually increasing steam passages advancing from periphery to center, with abutments increasing in size from periphery to center, so that the operating fluid, such as steam, as it decreases in pressure will have increased abutting surface to impinge on, thereby maintaining the turning moment uniform throughout the rotor.

MECHANISM FOR GOVERNING EXPLORIVE ENGINES.—H. DE LAVALETTE, 175 Avenue de Choisy, Paris, France. According to this invention the governing arrangement acts on the two valves to once which are both operated; when the speed exceeds a predetermined limit a lever is automatically engaged by a centrifugal governor in such a position that it keeps the exhaust valve constantly open notwithstanding the action of its return spring and prevents the admission valve, which is normally closed by action of another spring, from being opened by the controlling mechanism.

Railways and Their Accessories.

DUMP CAR.—T. WALKER, Paris, Ky. In this invention use is made of a truck, a platform thereon, receptacles mounted to repose on the platform, means for raising the inner ends of the receptacles to tilt the same, aprons hingedly and adjustably mounted on the platform and adapted to slidably receive the material dumped, and auxiliary aprons for removable attachment to the said aprons

Pertaining to Recreation.

GAME APPARATUS.—M. F. SHEA, Newport, R. I. This invention relates to games and has for its object to provide a device to be used as a counter or indicator with other games of chance or hazard. For this purpose use is made of a shell provided with a series of designating characters and a disk mounted to revolve in the shell when the shell is gyrated, the said disk having thereon an indicating pointer

GAME PIECE.—C. SCHUTZ, New York, N. Y. This invention has reference to game pieces, the inventor's more particular purpose being to provide a game piece adapted to slide along a smooth surface, such as that of a board or table the game piece being provided with a base and a rotund upper portion revolubly relatively to the base

GYROSCOPIC TOP.—J. F. O'BRIEN, Jarbridge, Nev. The present invention includes several novel features and improvements in gyroscopic tops, one relating to the construction of the shell or hollow sphere in which the gyroscope proper is inclosed, another being the construction and arrangement of the trunnion bearings for the gyroscopic wheels. The sphere will have on its exterior a delineation of a map of the world

Pertaining to Vehicles.

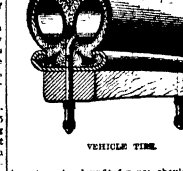
REFILLABLE BRAKE BLOCK.—J. H. SHELDON, Spokane, Wash. This improvement pertains to hollow or refillable brake blocks for use on wagons, or in places where a brake is customarily used. It provides an efficient brake block whereby surfaces may be replaced from time to time as they wear down. This is attained by positioning in a hollow frame or shell wooden blocks which may be replaced from time to time

APPARATUS FOR BRAKING VEHICLES.—LOUIS BOIRAULT, 20 Rue Lafitte, Paris, France. This invention has for its object an apparatus for braking of the kind in which the application of the brake shoes to the wheels is obtained by the action of a cam fixed to the axle of a pair of wheels and acting upon an operating lever which is caused to approach or separate from this cam in accordance with requirements

PUNCTURE CLOSING DEVICE FOR PNEUMATIC TIRES.—A. SMITH, Stuart, Neb. In applying the device to a pneumatic tire for the purpose of closing the edges of a rent, slit or puncture, the edges are drawn up together, and the device is slipped over the same, so that the body portions lie on opposite sides of the slit and below the same. The device is then compressed and thereby clamped firmly in place by means of suitable pliers, the edges of the opening being thus clamped together and closed air tight

SPRING WHEEL.—J. B. DUNLAP, Tulsa, Okla. In this construction of wheel an ordinary wheel may be employed, and a rim is arranged around the wheel proper and spaced therefrom, and springs are arranged between the wheel proper and the spaced rim, and the springs are so connected with both the wheel proper and the rim as to secure an efficient resilient connection between the wheel proper and the rim, so as to avoid rigid connections which would tend to crystallization.

VEHICLE TIRE.—JOHN W. DRISCOLL, Box 143, Central City, Colo. This invention is an improvement in pneumatic tires, and has in view a tire having pneumatic tubes so arranged that the chances of puncture are remote, each tube being separate and independent of the other tube, so that the tire



VEHICLE TIRE.

is not rendered unfit for use should one tube be deflated, a tongue being provided between the tubes and arranged to serve as a support for the tread under such conditions. The body of the tire is constructed of the usual materials, such as rubber, canvas, etc. The illustration herewith shows a perspective view of a portion of a tire embodying the invention, the same being shown applied to the rim of a wheel and in cross section.

NOTE.—Copies of any of these patents will be furnished by the SCIENTIFIC AMERICAN for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

NEW BOOKS, ETC.

INDUSTRIAL PLANTS. Their Arrangement and Construction. By Charles Price Day, New York: Engineering Magazine, 1911. 8vo, 294 pp. Price, $3

Careful study of the lay-out and construction of industrial buildings is the primary step toward efficiency and economy in manufacture. Industrial Plants is the outcome of Mr. Day's wide experience as consulting engineer in the construction of some of the most successful shops and factories in the country. His analyses follow a scientific method which takes into account not only the mere material factors of the problem, but which also looks ahead to the complexities introduced by the human elements—the employes upon whom environment exerts so powerful an influence toward good or bad work, mental or physical. In this phase of the problem the field of the new "scientific management" is invaded. The discussion progresses from the broad general principles of lay out and arrangement to a consideration of detail as required in specific instances. Charts, diagrams, and inserts point the lessons set forth. Further chapters bear upon the relationship between client and engineer, in "characteristic modern examples" several large factories of varying types are pictured and described, and modern construction and painting are shown in their relations to adequate lighting. A large insert of a hat factory has red and blue routing lines showing the sequence of operations in the manufacture of hats. Metal-working shops are given considerable space, and the considerations bearing on machine-drive are featured in diagrams. The work will well repay a careful reading

THE MUTATION THEORY. By Hugo de Vries. Vol. II. Chicago: The Open Court Publishing Company. 600 pp., numerous illustrations, 6 colored plates. Price, $4

It was our privilege to review, shortly after its publication, the first volume of this work, which is destined to take its place beside Darwin's "Origin of Species." That first volume was devoted to an elaborate discussion of experiments made by Prof. de Vries with Lamarck's evening primrose, and from the experiments made the conclusion was deduced that species may arise suddenly rather than by that age-long process for which Darwin argued. In the second volume, De Vries shows where the accepted Darwinian theory is wrong and where it will be necessary to substitute his own mutation ideas. Darwin himself foresaw the mutation theory, for he distinguished between the multiplication of his "pangenes" and their modification, and saw that without variation "natural selection could do nothing." With Darwin, variability of any kind supplies the field in which selection works and sinks to quite a subordinate position in comparison De Vries on the other hand, holds that specific characters do not arise by selection. An old-fashioned biologist may not be inclined to accept the mutation theory and the modern biologists are certainly in favor of it; he has at least shown the necessity of experimental study of species

BUILDING FOR PROFIT. By Reginald Pelham Bolton. New York: The De Vinne Press, 1911. 8vo, 15 pp. Illustrations

In this book the reader will find a effort to present scientifically the conditions which surround the planning, construction, and operation of a wide variety of metropolitan buildings during the last fifteen years. Here will be found the methods of analyzing and deciding values of improved real estate from the metropolitan standpoint, so that the investor may know what fundamental principles he may safely observe, what conditions and methods will assist him in deciding upon the preliminary proportions of a structure in advance of expenditure, what factors must be considered in deciding on rates of depreciation, and what considerations must be weighed in rebuilding. The author has reduced his subject to mathematical relation to its parts, as far as possible, and has reported to diagrams in order to afford ready reference to results. The subjects of the seven chapters which constitute the book are the following: I, Relation of Site and Building; II, Appreciation of Value of Land; III, Value Established by Building; IV, Depreciation of the Value of Buildings; V, Depreciation of Mechanical Equipments and Power; VI, Cost of Operating Buildings; VII, Manufacturing or Power Machinery

CONSERVATION OF SANITATION. By Ellen H. Richards. New York: John Wiley & Sons, 1911. 8vo, 305 pp. Price, $2.50

Compiled from the experiences of the past twenty years, "Conservation by Sanitation" takes the position that sanitation is as much a paying proposition as a railroad or a machine shop. It concerns itself with three of our greatest modern needs: good air, good water, and the disposal of wastes. Under the present system of tight buildings, good air is by no means "free." Air supply costs the modern householder one-fourth as much as his food supply, although its charges are disguised under the names of "rent" and "fuel." The average man perhaps finds it easier to realize the good and evil potentialities of water. The author's facts and figures in relation to water supply—its efficiency, protection, and regeneration are abundant and convincingly marshaled. The interdependence of town and county is graphically shown in the panoramic view of a stream's pollution. Succeeding chapters are devoted to waste and means of purifying water and disposing of contaminating wastes. In conclusion we are given a series of laboratory notes dealing with air and water tests and determinations. The volume is put forth as a laboratory guide, but it has a simplicity, sincerity and readableness rarely found in the exposition of scientific subjects and the writer never loses sight of the ultimate object of her mission to the welfare and advancement of the masses

SCIENCE FROM AN EASY CHAIR. By Sir Ray Lankester, K.C.B., F.R.S. New York: The Macmillan Company, 1911. 423 pp., 84 Illustrations. Price $1.75 net

The volume before us is a collection of papers contributed by Sir Ray Lankester to the London *Daily Telegraph*. The modern thirst for scientific knowledge can be met better satisfied than by scientists themselves if they will only take the trouble to write down to the level of the great reading public. To be sure, popular treatment usually means such simplification of expression that it is difficult to maintain strict scientific accuracy. It is given to but few men to teach the multitude scientific truths in a way that the multitude can understand. If we may judge from this collection of essays Sir Ray Lankester may be numbered among these. His essays are all of them so simply worded that any man with a high school education can understand them. The variety of subjects is great, ranging as it does from biology to astronomy from meteorology to chemistry from paleontology to "death rates"

THE SUGAR INDUSTRY OF MAURITIUS. A Study in Insurance, Including a Scheme of Insurance of the Cane Crop Against Damage Caused by Cyclones. By A. Walter, F.R.A.S. London: Arthur J. Humphreys, 1910. 8vo, 228 pp., illustrated

The work is in the nature of an investigation into what the author terms the correlative coefficients between the cane crop of Mauritius and the meteorological elements. The investigation is naturally under two headings. First as to a method of estimating the damage caused by cyclones etc. and, second, a consideration of insurance against such damage. Matters have now progressed to the point where not only is capitalist insurance of the crop possible, but also an insurance of the profits. A brief history of the agriculture and commerce of the island is included

HOW TO GROW VEGETABLES AND GARDEN HERBS. A Practical Handbook and Planting Table for the Vegetable Gardener. By Allen French. New York: The Macmillan Company, 1911. 8vo, 312 pp., illustrations. $1.75 net

This is a new edition of the book previously published under the title "The Book of Vegetables." The writer confesses that at the earlier stages of his career as a market gardener he made many mistakes, some with costly mistakes and failures, and such a reference book as this book in his possession. The seasons and methods given are for the northern United States and the intimation is that of New York. Such vegetables as are of local interest and its uses given after which such points as soil, moisture, proper planting distances, and methods of handling are taken up. There is a table showing seed lengths, and ounce values, and an index giving immediate access to any desired information

MODERN GEOGRAPHY. By Marion I. Newbigin, D.Sc. New York: Henry Holt & Co., 1911. 12mo, 256 pp., Illustrated. Price, 75 cents net

"Modern Geography" is one of the issues of the Home University Library of Modern Knowledge, a commendable effort to continue the educative work of the serious magazine article. After a short review of the beginnings of modern geography surface relief and the process of erosion is studied, together with ice and its action. Climate and weather is the subject of another chapter followed by studies in plant geography and animal life. This brings us to the most interesting division of the little volume: that dealing with the races of Europe and their origin. A discussion of minerals and their distribution in relation to industries and towns fittingly concludes the body of the work. A descriptive list of works of reference is an adjunct to be commended

LA VITA MECCANICHE. Loro Calcolo e Costruzione. Manuale Teorico Pratico ad Uso dei Capi-officina meccanici Industriali, Capitecnici, Ingegneri Insegnanti di tecnologie meccaniche nelle Scuole Industriali e d'arti e mestieri, Tornitori, Fabbri, Alunni di Scuole Industriali. Milan: Ulrico Hoepli, 1911. 12mo, 215 pp., 110 cuts, 48 tables

The title and the subtitles form a sufficiently eloquent notice of the little work, which has the clear print and profuse illustration that distinguish the Hoepli handbooks

William Napier Shaw

(continued from page 163)

For a decade and more the most promising investigations in meteorology have been those relating to the exploration of the upper air. Accordingly, we find that Dr Shaw has taken a leading part in securing to Great Britain the enviable position she now holds in the field of aerology. I need only refer to a recent publication of the Meteorological Office. The Free Atmosphere in the Region of the British Isles," a large part of which was Dr Shaw's individual product, to illustrate his and the office's activity in this field.

Another recent development of meteorology is the discovery of striking correlations in atmospheric conditions at points on the earth's surface far remote from one another. Dr Shaw has within this branch of the science, devoted special attention to the relation borne by the southeast trade wind to the other currents of the general circulation, and to the secondary phenomena connected with them. This led him a few years ago to the discovery of a remarkable parallelism between the fluctuations of this wind and those of the rainfall in southern England.

To the present writer meteorology appears to be just now entering upon an era of much enhanced prestige, due to circumstances that may be stated in the following syllogism: Aeronauts must cultivate meteorology. We shall all soon be aeronauts. Ergo we must all cultivate meteorology, which henceforth must be looked upon as one of the most useful and important branches of science. Conversely, meteorologists must turn their attention to the problems of aeronautics. The director of the Meteorological Office is a member of the Advisory Committee on Aeronautics appointed in April, 1909, by the British government. The membership of the committee includes some of the highest scientific talent of England, with Lord Rayleigh as president. To its admirable report for 1909-10 Dr Shaw contributes four memoirs on meteorological topics of interest to aeronauts, and in these memoirs he shows how fully he realizes and how unreservedly he accepts the new tasks of meteorology.

Besides the textbook of physics already mentioned, and scores of scientific papers and reports Shaw has written a book on heat and one on ventilation. On the latter subject he is probably the highest authority in England, and he has been called upon from time to time, to report on the ventilation of various public buildings, including the House of Commons. In recent years he has found time to deliver a number of lectures on meteorological subjects—as reader in meteorology at the University of London, and in other capacities—some of which are about to be published in two volumes entitled "Forecasts of Weather" and "The Climates of the British Possessions."

His academic honors include the LL.D of Aberdeen 1906, Sc.D., Dublin, 1908, Sc.D., Harvard 1908, and Sc.D., Manchester 1910. He is an honorary member of the Meteorological Societies of Austria, Germany and Mauritius. In 1908 he was president of Section A of the British Association. In 1909 he attended the installation of Lowell as president of Harvard University representing his college Emmanuel, which was also the alma mater of John Harvard. In 1910 he received the Symons gold medal of the Royal Meteorological Society.

The Knight Valveless Engine

(continued from page 164)

stroke of the motor the exhaust passage begins to open. The inner sleeve is moving down with the piston, and the passage is between the lower edge of the inner sleeve slot and the lower edge of the junk ring in the head, the outer sleeve being practically stationary at the top of its stroke. The outer sleeve starts on its downward stroke and, gaining in speed as the inner does, leaves a clear opening for the exhaust. The piston is now one third up on its exhaust stroke, and the passage is closed by the upper edge of the outer sleeve slot in passing the lower edge of the exhaust port in the cylinder as the piston reaches its top center. The four cycles or strokes of the engine: suction, compression, explosion, and exhaust) have now been completed; the crank has turned twice, the eccentrics have driven the sleeves once, and the cycle of operation is now ready to be repeated.

The timing shown is not different from that ordinarily used in poppet valve engines. Any timing of the valves can be secured, however, by varying the "lead" between the eccentrics that operate the two sleeves and by properly locating the slots in the sleeves. The amount of valve opening is practically unlimited and is governed by the width of slot in the sleeves and the "throw" of the eccentrics that drive and determine the travel of the sleeves.

This valve area need not be much greater than that of a poppet valve. The equivalent of increased valve area is gained, however, by the directness of the valve openings and the absence of restrictions in the gas passages made possible by this construction.

The fourth diagram of Fig 2 shows that the compression space is contained entirely within the inner sleeve and that the fit or clearance between the sleeves has no effect either on the amount of the compression or upon the tightness of the compression space. The diagram also shows the general shape of the combustion chamber. It is evident that a minimum amount of surface is presented for the volume contained, so that the ideal spherical shape desired in gasoline motors is approximated.

The simplicity of the entire valve mechanism is apparent. The number of parts are few. All the working surfaces are cylindrical and consequently capable of easy and accurate machining. The bearing surfaces are large and easily fitted, and with a fair amount of lubrication should last indefinitely. The operation and movement of the parts present no new principle in mechanics.

The operation of these sleeve valves is absolutely quiet, accurate, efficient, and absolutely independent of the speed of the engine, which last feature is in great part responsible for the improved performance of Knight automobile motors.

A test of two motors identical except for the valve mechanism will show a certain decided increase in power in the sleeve valve motor, an increase in power which becomes more and more apparent as the speed of the engine increases. At low speeds the difference is not noticeable, for the cam and spring operated valves are then at their best. At high speed, however, the action of the poppet becomes very uncertain and the "timing" is uneven. The sleeve valve is not affected by high speed. The resistance offered to the passage of exhaust and inlet gases by the shape of the poppet valve openings is far greater than that of the sleeve valves. This limits the power output of the poppet valve motor.

Continued use of the Knight motor seems to improve it. The sliding sleeves apparently lap themselves into a better working fit. The lips of the slots in the sleeves remain clean and no difficulty in the lubrication or cooling of the motor is likely to develop.

The lubrication is generally effected by a splash system. In other words the oil is lifted from the base of the engine by the connecting rods and thrown upon the walls of the piston and sleeves. The sleeves are generally provided with a number of oil grooves, and the oil is lifted both by the wiping of the surfaces and the suction of the motor.

The cylinders are cooled by water. The usual centrifugal pump circulates water through the water jacketing of the cylinder and down into the water-jacketed head.

The motor here shown is of 4¼-inch bore by 5½-inch stroke. The travel of the sleeve is 1¾ inch.

There are now upward of six thousand of these Knight type motors in successful operation and their development and manufacture in this country will be watched with interest.

Lessons of the 1911 International Cup Race

(Continued from page 170)

The central frame, very deep at the front and of a significant fusiform shape, is entirely covered with fabric, reducing the air resistance immensely but adding in skin-frictional resistance. The shape of the body in section is rectangular, thus giving a large area of vertical and horizontal surface to aid in turning and in maintaining any given direction. Weymann and the other Nieuport pilots were able to negotiate the sharp turns with more ease in a calm than in a wind but were never able to attain the degree of "banking" repeatedly exhibited by the Wright. The large area of "directive" surface given by the body, would prevent any such sharp pivoting as is obtainable with the Dayton product.

The shape and sections of the plane are given in the diagrams. The entering edge of the plane profile is smooth and lacks any pronounced dipping. The plane is thinnest at the outer ends and thickest near the center of each wing—a curious feature that adds considerably to the strength.

The disposition of the seat in the frame and the shape of the rudders and tail are evident. The fixed semicircular tail surface is non-lifting and in fact is at a slight negative angle when the machine is in full flight. The two semicircular flaps at the rear of it constitute the elevation rudder and are operated by the forward-back motion of a large control lever. This same lever, when moved from side to side, operates the small single rudder for direction situated at the extreme rear.

The most noticeable and admirable feature of the entire design is the extreme reduction in the number of stay wires and projecting spars. Outside of the body the only source of pure head-resistance is a four-piece mast to which the planes are braced and the simple chassis. The latter consists merely of a strong ash frame and skid and two wheels mounted on a laminated steel spring—a magnificent combination of simplicity, utility, and strength.

The planes are double surfaced, 28 feet in span and with a chord measuring 6 feet 10 inches at the body, gradually decreasing to 5 feet 8 inches at the tips. The plane is warped for transverse control by means of a foot yoke actuating the inclined rod appearing on the chassis and to the ends of which the warping wires are attached.

The entire length of the machine is 25 feet.

The surface area of the supporting plane is in the neighborhood of 150 square feet. The weight with operator and fuel as flown in the race was nearly 700 pounds. This gives a loading of 4.66 pounds per square foot. The aspect ratio is roughly 5 to 1.

Weymann flew his Nieuport tail-high at an extremely low angle of incidence, often 1 degree or less—an interesting and suggestive fact.

THE BLÉRIOT XXIII.

This racing type of Blériot flown by Hamel and by Leblanc was originally about 22 feet in span. But at the last moment M. Blériot deemed it wise to clip the ends of the wings, finally reducing the span of the machine used by Leblanc to almost 17 feet. The chord of this type measured 3½ feet, so that the surface area was in the neighborhood of but 60 square feet! This is less than the area of the elevation rudder, alone, on the old 1909 Wright biplane.

The appearance presented by this machine was in consequence little short of ridiculous. At the front end of the long tapering frame was mounted the 100 H.P. 14-cylinder Gnome engine driving a Rogy propeller, the same kind of power plant used by Weymann.

Major Squier once defined the limit of the aeroplane as a helicopter flying horizontally; M. Blériot is evidently aiming for this goal—with what success remains to be seen.

The entire length of the apparatus was about 24 feet. The rudders at the rear and the warping were operated by the usual Blériot "cloche" and pedal system.

The weight with aviator aboard was nearly 550 pounds, thus giving a loading of over 9 pounds per square foot of surface, the high-water mark in aviation. The angle of incidence used in flight by Leblanc was much higher than that of Weymann—approximately 7 or 8 degrees.

In straightaway flight the speed of Leblanc is said to have been tremendous, but on turns he was forced to go so wide that he lost ground, and eventually the race. Hamel, lacking the expert-

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MISCELLANEOUS.

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mess of Leblanc, came to grief on the first turn, being unable to recover from the inclination because of the inadequacy of his supporting surface. This is a feature for which this type deserves to be severely criticised. It merely points to what an absurd sacrifice M. Blériot went to gain a little in speed.

THE WRIGHT BIPLANE.

This "Baby" type is already familiar to many, and will be recognized as a counterpart of the small machines flown at Belmont Park last year Mr. Ogilvie used an N. E. C. engine rated at 50 H.P. and with it attained a speed only slightly greater than with the 80 H.P. Wright engine used by him last year

The biplane measured 21¼ feet in span, and 3¼ feet in depth The total area was 145 square feet. The aspect ratio was over 6 to 1, and the loading about 6 pounds per square foot

The rudder and control systems are precisely the same as on all the standard Wright types

Mr. Ogilvie introduced an innovation in fixing to the next to last strut near either end of the main biplane cell, single vertical surfaces, to act as keels These doubtless added to the resistance but Mr Ogilvie found that they aided in steering.

The noticeable fact about this machine in flight was the manner in which it appeared to "drag" as compared with its swifter competitors This in a measure was due to its lower power, but more particularly to its very much higher resistance

The main features in which the types differ may be summed up as follows: The Nieuport had a light loading and a very small angle of incidence, which, added to the small resistance of the framing, made the total resistance to be overcome by the propeller thrust very small The Blériot had a high angle of incidence, a frame of considerable resistance, and a very small surface. The power plants being the same, it is evident that the Blériot, with almost only one-third of the surface, offered as great a resistance to motion as did the Nieuport This does not only speak well for the Nieuport but badly for the Blériot

The Wright was lower powered but had a medium loading with a very high framing resistance

COMPARATIVE FEATURES

The sections of the planes of these three types are given M Eiffel in his classic experiments has investigated all these sections. For the Wright, the best ratio of lift to drift is obtained in the neighborhood of 2 or 3 deg.; for the Blériot at 3 deg. and for the Nieuport at 6 deg The normal angle of flight of the low-powered Nieuport is at 6 deg—the most efficient one Any higher power for the same weight, results in higher speed only upon reducing the angle of incidence The speed does not increase proportionally with the horse-power Upon using a 100 H.P. motor—as did Weymann—only a slight increase of speed is attained over a 70 H.P. Since he appeared to be flying at as low an angle as possible the conclusion is at once drawn that for lifting this particular weight of machine a limit has been reached Upon further increasing the motive power, to offset the tendency the machine would have to ascend, it would almost appear necessary to actually add weight to it, to hold it down This merely emphasizes the precise balance that exists in aeroplane design between weight, speed, and power

M Eiffel's investigations show a particularly interesting difference in the aerodynamics of these types On the Wright, he found the distribution of pressure to be very high at the extreme entering edge region of the plane, the pressure decreasing in intensity toward the rear. On the Blériot the total pressure, suction on the upper face and pressure on the under face, was a maximum at one-fifth of the chord from the leading edge, but as on the Wright, decreased sharply toward the rear On the Nieuport, a different situation was found The pressure was a maximum much nearer the center of the plane, sloping easily to the front and the rear, thus indicating a far more uniform intensity and distribution of pressure. This has a great deal to do with explaining the high efficiency of the Nieuport product.

LESSONS OF THE RACE.

What the Wright gained in strength and stability it lost in its inherently higher resistance—at once stamping the biplane as a slow-speed machine

The monoplanes at last proved themselves beyond doubt the ideal type for rapid flying. Two important considerations result from actual observation of the flight of Weymann's Nieuport and Leblanc's Blériot Had Weymann had less surface on the straight stretches he could have attained a much higher average speed, but at the turns in order to "bank" with a proper degree of safety and rapidity he needed every square inch of surface he had On the other hand Leblanc had about as little surface as possible for straightaway flight, but on turns he was forced to go far out of his course and skid to an alarming extent Had Leblanc been provided with more surface at the turns he could have "banked" more sharply and thus greatly increased his average speed. The two facts point unerringly to the immense advantages that would be possessed by a machine with variable surfaces—reduced to a minimum in straight flight, and spread to a maximum in landing, starting, and negotiating sharp turns Never before has the real significance of the variable surface aeroplane been more powerfully suggested—a key to still faster flight.

The important and pronounced characteristics exhibited by the machines in making sharp turns should permanently fix these as one of the characteristic requirements of the contest To further test the machines more difficult maneuvers should be made imperative, such as clearing certain altitudes and turning both to right and left.

In addition to this time should be taken from standstill to standstill thus bringing into the contest the highly important elements of starting and alighting It is not unlikely that the 1912 cup race will see speeds of 90 miles an hour reached and perhaps surpassed

Etching Metals by Electricity

(Continued from page 178)

the fish-glue preparation in the same way as the albumen, draining the excess only partially off the plate Then insert it in a whirler, spin this around at a moderate speed over the flame of a gas stove, about one foot above the flame In the course of about two minutes the plate can be removed from the whirler, stood on end to cool, then placed upon a negative that has been made with a screen of about 100 lines to the inch The pad of cardboard is now placed upon the back of the plate The back board is inserted, and fixed with considerable pressure so as to insure complete contact Now place the frame out in the sunlight An exposure of from two to five minutes will be required Take the printing frame to the dark room, remove the plate under an orange-colored light and pour over it a solution of aniline violet in water A teaspoonful of the dye to a pint of water is about the right amount Drain off the dye and allow a very gentle stream of water to flow over the plate Wipe the surface with a tuft of wetted absorbent cotton; this must be done with great care, and a very light touch The image will now appear in beautiful violet dots all over the plate, which must be allowed to drain and dry, or it may be replaced in the whirler, and dried in the same manner that was used to set the sensitive coating The image must now be burnt in Take the plate, grip it with a pair of flat-nose pliers at one corner hold it over a gas-stove flame, turned down rather low Turn the plate around, keeping this up until the image seems to disappear Continue the heat and motion until the image turns to a medium chestnut brown Remove the plate at this stage, brush the back and edges all over with asphaltum varnish, allow to cool, when it is ready for the etching. This must be carried out in just the same way as for zinc, using a separate bath of salt and acid, while the time for etching will be about the same as for zinc This protective top is called enamel; it will resist the etching liquid perfectly. If the etching is to be made in very fine dots, only two or three minutes is necessary, when the face can be brushed well over in clean water, the asphaltum varnish

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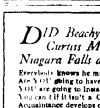


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removed, as in the case of zinc, the plate trimmed and mounted in just the same way upon a wooden block. The current used in this case, generated by the battery described, will be about three or four amperes, and the electromotive force three volts.

Fig 1 of the illustration was etched as described on zinc, and Fig. 2 upon copper

The Current Supplement

WE have had occasion recently to discuss in our columns the extension of docking facilities for the port of New York, rendered imperative by the ever-increasing size of trans-Atlantic liners. This week's issue of our SUPPLEMENT, No. 1859, brings an account of the steps taken at Southampton by our cousins across the sea to face the situation. Our English correspondent writes on the new docks in the course of construction for the White Star Line.—The readers of the SCIENTIFIC AMERICAN are familiar with the Soya bean. This remarkable seed yields a "vegetable milk," from which may be derived, as from animal milk, a cheese and a species of casein. These points and others are dealt with in an article on the "Extended Utilization of Soya Bean Products."—An illustrated account of the methods employed in measuring radio-activity is given by André Conte.—The fourth instalment of Donald Murray's valuable article on Printing Telegraphy appears in this issue.—How much money is lost to railway companies by locomotives held up in the repair shop is the question dealt with in an article entitled "What is a Locomotive's Time Worth."—The dimensions of the M'Adoo tunnel impose certain restrictions upon the cars operated therein. These cars are illustrated and described in a special article.—It is extremely difficult to extinguish fires in such inflammable liquids as kerosene. What can be done by spreading a blanket of foam over the surface of such burning liquid is described in an article from *Prometheus*.—W. A. DuPuy gives an account of Dr. L. W. Austin, Government Expert on Radio-Telegraphy, and his important achievements.—E. F. Harran, of the Calcutta Port Commission, writes on the Indian tea trade.—An illustrated article is devoted to "The Influence of Erosion by Water in Modeling the Landscape."—Some notes on "Underground Water for Public Use" are cited from a recent pamphlet issued by the United States Geological Survey.—Prof. Charles E. Munroe writes on "Our Dependence upon the Nitrate Supply for National Defense."—Prof. Dobereck speaks on the subject of "The Proper Motions of the Fixed Stars."

Cuttlefish Farms

AT several points on the British coasts there are located cuttlefish farms, where the little creatures are kept in tanks or ponds to be "milked" of their ink.

The pond or tank is connected with the sea by a pipe, and a thousand or more cuttles are kept in a single one. They present a curious sight as they move about, trailing their long arms and starting out of their bulging eyes.

They are guarded by screens with a view to preventing fright, for, if they are suddenly scared, they will emit their "milk" in the water, a dead loss to the cuttlefish farmer. The fluid, or milk, is very valuable, and each cuttle will yield about $3.50 worth a year. It is secreted in a bag, which can be opened and closed at will, the cuttle ejecting the fluid to darken the water so that it may escape unseen when attacked.

The best cuttlefish are obtained in China, where for some reason or other, they produce the best quality of "milk."

When the farmer considers it an opportune time to milk the cuttles he proceeds by opening the sluices of the ponds and gently agitating the water. The cuttles then swim around the pond, and as soon as one passes through the sluice is closed. The cuttle passes down a small channel into a basin or metal receptacle, and as soon as it is securely there the water is drained off. It is then frightened, and at once squirts the fluid from the bag. When it is exhausted it is lifted out, the milk is collected, and the basin is prepared for another.

Notes and Queries

Kindly keep your queries on separate sheets of paper when corresponding about such matters as patents, subscriptions, books, etc. This will greatly facilitate answering your questions, as in many cases they have to be referred to experts. The full name and address should be given on every sheet. No attention will be paid to unsigned queries. Full hints to correspondents are printed from time to time and will be mailed on request.

(12518) S. R. W. asks: In your Railroad number I note in one of the articles (page 590) that reference is made to the fact that in some instances the train dispatcher is able to communicate with the conductor of the train by telephone. Will you please inform me as to the construction and methods employed in this system? A. Communication was made with moving trains a good many years ago. A system which bears the name of Mr. Edison has been used. It employs the induction of the current to produce a current in the telephone circuit on the car of the train. The main circuit is by the side of the road. The receiving circuit is on one of the cars of the train. The induction of the current in the main circuit is sufficient to generate a current in the circuit on the car, and thus enable one to hear the message. By the same means a message can be sent from the train, and these circuits have been used by passengers to send and receive messages en *route*.

(12519) A. H. M. asks: In regard to query 12470 of June 24th, 1911, issue, I would like to state the following: It is a well-known fact among those who have seen service on submarine vessels, that it is possible to balance a submarine boat at any desired depth. The greater the depth at which it is desired to balance the boat, then the greater the amount of negative buoyancy (in the form of water ballast) which must be carried. From this it would be inferred that the density of sea water is not quite a ratio to the depth of the water, and I am of the opinion that lack of circulation as the depth increases naturally results in greater concentration and density. Theory leads us to believe that an object that is heavy enough to sink will continue to sink to the bottom, but the fact that water is not throughout a medium of uniform density is often not considered. A fine compressibility of water is about 1/22000 part per atmosphere, and an increase of one atmosphere is had at about 33 feet below the surface of the sea. From this statement it is not difficult to calculate the number of pounds of water ballast required by a submarine of known volume and weight to balance the increase of buoyancy due to depth. This is, however, not the question in the query referred to. The fact is that if a heavy body sinks in water, it will continue to sink till it reaches the bottom if its weight is not changed. This the submarine would do if its weight was not changed by changing the quantity of water in it. The difference in density due to the quantity of salts dissolved in the water is not great at different places and does not affect the result to any great extent. The continuous sinking of a body in the sea is due to the fact that it is compressed more and made denser by its deeper submersion than the sea water is at the same depth. The submarine is not compressed in sinking to ordinary depths, but its volume and weight are changed by admitting water to make it sink and removing water to make it rise.

(12520) R. E. T. says. My house is frame with slate roof. I use electric light 115-volt, 60-cycle two-wire system, with the wires entering at the top of house. The wiring was put in some years ago. Would it be better to throw the main switch during an electrical storm or not? One side of the transformer is grounded, and I have combination gas and electric fixtures. A. If you have not a good lightning arrester at the point where the electric wires enter your building, you would better have one put on without delay. Even after this is done, the house is better protected from lightning if the main switch is open during a thunder storm. In some places the switch at the generating station is opened during a thunder storm and all lights are cut off.

(12521) E. P. says. I am experimenting with electricity, and use a lot of dry cell batteries in my work, and I find it very expensive to buy new batteries. Won't you kindly tell me a way by which I can restore my old batteries again? A. We regret to have to say that there is no way of fully restoring old dry cells. They are generally thrown away when exhausted. Some have punched holes in the zinc cases, and put the whole in a glass jar with a solution of ammonium chloride. They will then give some more service, but not enough so that the operation is profitable. Some have dug out the top and soaked the cell in the ammonium chloride solution. This is the better way. If time and labor are of little value, one can perhaps profitably work on old dry cells; otherwise, not.



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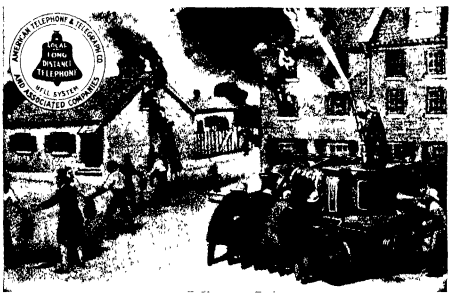
Aeronautic Notes

Current Aviation Meets.—The first big aviation meet of the present year in the Middle West opened on the 12th inst. in Chicago. Over twoscore aeroplanes of different types, piloted by the leading American aviators, were entered, and $80,000 in prize money was competed for. The meet was held at Grant Park on the shore of Lake Michigan, which, though a windy spot, did not affect the flights materially. The first big meet of the year in the East opens at Boston on the 26th, while a second Western meet will be held at St. Louis, beginning September 30th.

Big Prizes for Cross-country Flights.—The offer of $10,000 to Harry Atwood for a 1,000-mile cross-country flight, which is said to have been made recently by a prominent patent attorney of Washington, has caused this daring aviator to attempt a flight from either Milwaukee or St. Louis to New York in the near future. A prize of a like amount has been offered by Gen. Charles M. Taylor, the proprietor of the Boston *Globe*, for a 150-mile interstate monoplane circuit race during the Boston meet. This is the second $10,000 prize donated by General Taylor, as he gave a similar amount a year ago for a flight from the aviation field at Squantum to the Boston Light and return. This prize was won by Grahame-White with his Blériot monoplane. A prize of $7,500 has also been put up for biplanes to race over the same course on September 2nd. The cities included in the circuit are Nashua, N. H., Worcester, Mass., and Providence, R. I. The $10,000 will be divided into three prizes of $7,500, $1,500 and $1,000, respectively, while in the biplane race the prizes will be $5,000, $1,500 and $1,000.

The First Inter-city Aeroplane Race.—The first aeroplane race across country from New York to Philadelphia was flown on Saturday, August 5th, when Messrs. Beachy, Ely, and Robinson of the Curtiss force started from Governors Island, flew up the Hudson to Thirty-third Street, circled over the roof of the Gimbel building, and headed for Philadelphia. Beachy, who has already made a name for himself by his flight over Niagara Falls a short time ago, won the race, his time from store to store for the 90 miles being ¾ minute less than two hours, including a stop at Trenton, in order to take on fuel. Robinson was second in two hours and one-half, while Ely only got as far as Princeton Junction. Just before reaching Philadelphia Beachy passed into a shower and was thoroughly soaked ere he circled above the Gimbel building in Philadelphia, saluted the statue of William Penn on top of the City Hall, and landed in Fairmount Park. Notwithstanding this fact, he gave a fine exhibition flight while waiting for his brother aviator. All three aviators used Curtiss 50 horse-power biplanes having Keyllnder V-type motors. The prize was $5,000 in cash. It was put up by the Gimbel firm with an idea of encouraging cross-country inter-city aeroplane racing.

A New Distance Record for the Michelin Trophy.—M. Vedrines, the winner of the Paris-Madrid race, made a trial for the Michelin trophy on the 9th inst. in France, and succeeded in covering 800 kilometers (497.09 miles) in 7 hours, 58 minutes, and 36 seconds. This corresponds to an average speed of 62¼ miles an hour, which is excellent for a sustained flight over a closed circuit. This new record supplants that made by M. Loridan of 469 miles in 11¾ hours on the 21st ult. The new record was made with a Morane monoplane instead of with a Farman biplane which was used by M. Loridan. In competing for the trophy this year the flight must be made across country, back and forth between two points from 50 to 100 kilometers apart. Competitors may descend as often as they please to take on fuel or make repairs, but no part of the machine can be replaced that is sealed by the officials. An average speed of 50 kilometers (31 miles) an hour must be maintained. The winner of the trophy this year will be the pilot who, before November 1st, has covered the greatest distance over a closed circuit. This distance must exceed the 552.935 kilometers (552.21 miles) scored by M. Tabuteau last year.



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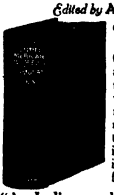
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IRA REMSEN

President of Johns Hopkins University, will tell in the Scientific American for next week how the

UNITED STATES REFEREE BOARD

came to be appointed, explaining certain facts not generally known to the public. This article was prepared for the September Magazine issue and in its place, President Remsen will write for that issue on Artificial Rubber.

Next week's issue will also contain an appeal to farmers to

CONVERT ABANDONED MILLS INTO ELECTRIC POWER PLANTS

by T. Commerford Martin, and Putnam A. Bates, who will explain just how this can be done.

TWO THOUSAND FOOT AIRSHIP OF THE FUTURE

is the title of an interesting article by Carl Dienstbach.

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THE GIANT AIRSHIP OF THE FUTURE COMPARED WITH A MODERN BATTLESHIP

The outer envelope has been broken away to show the interior trussing and the accommodations for passengers.--[See page 185]

SCIENTIFIC AMERICAN

Founded 1845

NEW YORK, SATURDAY, AUGUST 26, 1911

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The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are striking, the articles short, and the facts authentic, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

The purpose of this journal is to record accurately and in simple terms, the world's progress in scientific knowledge and industrial achievement. It seeks to present this information in a form so readable and readily understood, as to set forth and emphasize the inherent charm and fascination of science

Aeroplane Touring vs. Exhibition Flying

LAST week the followers of aviation in this country were given an opportunity to contrast the aeroplane as a practical means of transport across country with the aeroplane as a provider of sensational amusement.

No more striking demonstration of the utility of the aeroplane for pleasant and rapid touring could have been given than Atwood's flight, at an average speed of between forty and fifty miles an hour for the first half of his journey from St. Louis to Chicago and New York, a distance of about 1,265 miles, or double that covered by him in his memorable flight from Boston to New York, Atlantic City, and Washington some weeks ago.

On the other hand, the dangers of exhibition flying on the edge of, and over, a large body of water were distressingly brought out by the deaths from bad falls of two promising young men, both of whom, had they lived, would in all probability have contributed to the progress of aviation in America.

These two fatal accidents seem to have been caused in much the same way, i. e., as the result of a sudden descent at a sharp angle with power on, ending in a quick leveling of the machine before it struck the ground or water. The terrific strain imposed upon the planes and guys, amounting to many times that caused by normal flight (as explained by Dr. Zahm in an article on another page), caused the guys to give way, and the wings or planes to collapse, after which the aeroplane fell precipitately to the ground or the water of the lake.

The first machine that collapsed in this way was a Baldwin biplane driven by William Badger, a wealthy young amateur aviator of Pittsburg. The planes crumpled up and the aeroplane fell into a pit. As is usual in an accident of this sort with a biplane, the motor, which is mounted directly behind the man, fell upon the aviator, fracturing his skull and badly mutilating his body. He died within three-quarters of an hour.

The second fatality, which occurred only a short time after the first one, happened to St. Croix Johnstone, the leading pilot of the Moisant monoplane and the holder of the American endurance record of over four hours in the air. Johnstone had been flying for two and a half hours, most of the time over the lake, when he made a sharp descent from a height of some 1,500 feet. Suddenly, when less than 500 feet above the surface of Lake Michigan, the aviator lost control and the machine plunged into the water. Johnstone was unable to save himself in the way that Arthur Stone did under similar circumstances two days later, namely, by diving from the machine just before it struck, and he was carried below the surface and drowned. Robinson in a Curtiss hydro-biplane was flying nearby at the time. He alighted upon the water and tried to render assistance, but was unable alone to extricate his fellow flyer.

While the two fatal accidents were not due to the wind, this had much to do with several of the other disasters. The Windy City made good its name by producing exceedingly strong breezes for the flyers to battle with. One of the most peculiar accidents happened on the second day, when McCurdy's biplane is said to have caught fire from contact with some high-tension electric light wires. The machine was entirely consumed. The third day of the meet Simon, in a Blériot monoplane, and Hammond, in a Baldwin biplane, each fell into Lake Michigan. The latter dived from his machine before it struck the water, while the French aviator remained in his monoplane until he was rescued.

In making his long-distance tour Harry Atwood has shown the aeroplane, when favored with good weather, to be fully as dependable as the automobile. Besides this it is a speedier, cleanlier, and more pleasurable means of transport. The $10,000 prize Atwood expects to win, in addition to the various sums paid him for flying over towns and alighting, has made his remuneration from his ten days' outing several times greater than that of the best aviator at the Chicago meet. In addition to this, his flight has given many more people, gratis, their first view of an aeroplane.

We are glad to note that at the Boston meet, which opens to-day, there will be two cross-country circuit races for monoplanes and biplanes respectively, for prize money aggregating $17,500. Generosity of this sort by the newspapers of the country will do more to introduce the aeroplane as a practical machine than hundreds of aviation meets, ending in death and financial failure.

Artificial Frogs

A CABLE dispatch from Paris last week brought the startling news that Prof. Bataillon, the well-known biologist, has succeeded in producing "artificial frogs." Announcements such as this have become so frequent of late that they have almost ceased to startle the *blase* newspaper-reader; but whether one is startled or not, the announcements are essentially false and misleading. We are in fact no nearer the creation of "artificial frogs" or "artificial life" in any form, so far as actual control of the conditions that lead to the origin of living matter is concerned, than we were a dozen years ago.

The problems involved in the work which leads to these sensational announcements are of two entirely different kinds. In the first place we have the question of the physical and chemical processes that go on in the living protoplasm, with the attempt to reproduce as far as possible a combination of molecules that will behave in some respects as does the living matter of a cell. If we could succeed in bringing together from the bottles in the laboratory a combination of substances that would react upon one another and upon the environment as does the mass of substances we call an "Amoeba" we should have succeeded in creating "artificial life." Many attempts have no doubt been made to create life in this sense. And many attempts—from those of Butschli to those of Leduc—have succeeded so far that they have reproduced some of the peculiarities of living things in non-living matter. But Prof. Bataillon did not try to do anything like this. His problem was an entirely different kind.

He was concerned chiefly with the question, "How does the sperm cause the egg to develop?" In attempting to reduce the influence of the sperm upon the egg to physical and chemical terms, the biologist may be said to deal with the creation of life, but the use of these terms in that sense is purely metaphorical. At any rate, this is the nature of the general problem with which Prof. Bataillon is concerned, and his results are the logical successors of earlier experiments along the same line. Starting with Prof. Jacques Loeb's experiments, in which the unfertilized eggs of sea-urchins were induced to develop by the action of physical forces (osmotic pressure) and by various chemicals, passing to Loeb's later experiments in which the chemical action was analysed further into its electrical factors, and from these to the experiments of Delage, who induced fertilization by means of electric charges, we have a continuous series of contributions to the solution of this problem. But from Delage's "artificial parthenogenesis" by means of electrical charges through the surrounding medium, to Bataillon's artificial parthenogenesis by means of chemical charges through the unfertilized egg itself, is only a step—but an important step.

In all of these experiments the biologist has before him well-defined problems; in none of them does the experimenter for a moment think that he is making "artificial life." For if we could succeed in making all frog's eggs or sea-urchin eggs develop into adults without fertilization, we should not be creating life at all; we should simply cause eggs to develop under artificial conditions. To create life we should have to provide the egg artificially, as well as the stimulus for its development.

Nevertheless these experiments are of importance, as well as of interest, for they lead not only to a better *understanding* of the fundamental processes, but also, eventually, to a surer *control* of vital processes, in animals and in plants. Without any illusions as to the likelihood of artificial frogs being sent here from France next year, or even the year after, we may still find it worth while to learn what has actually been accomplished in these two lines of research. We shall accordingly present to our readers shortly an account of the experiments made to reproduce the physical and chemical peculiarities of living matter, and those made to replace the vital action of one factor in reproduction (the sperm) by chemical and physical processes.

The Abandoned Mill and the Farmer

SCATTERED broadcast throughout our land are hundreds of water mills, long since abandoned. Relics of busy centers these, where the grind of the millstones, the clatter of machinery, and the creaking of the old water-wheel, once vied with the roar of the industrious stream. Now all is still, within the old mill walls, and the dust, the moss, the rot, and the rust, show that it has long since given up its struggle with the progress of modern industry. Wheat is now ground in steam-driven mills, a hundred fold greater, and little manufacturing plants have moved to the city, where they can avail themselves of steam and electric power close to the consumer of their products. But back in the country the idle mill stream still pours over the old dam, and dashes down the spillway in utter abandon—hundreds, may be thousands of horse-power literally going to waste—while in the adjacent fields the farmer, whom it once served, still toils at his plough and sends his grain a thousand miles away to the steam mill.

Is this really progress? Can we feel justly proud of the industrial advancement of our great nation, while such prodigality exists? But what can be done with these water-powers? A few of them, the larger ones of course, which are advantageously situated, have been set to work generating electricity for light and power purposes. But the smaller ones—have they no further value? Of course they have; and we need not look far afield to find a ready market for this power, small though it may be. Side by side with these idle streams, are the over-driven farmers, whose labor troubles have multiplied appallingly, and who are crying for help to do the necessary work on their farms. Why should such an anomalous condition continue any longer? Why not convert these old mills into electric power stations, and let electricity lighten the farmer's tasks? The first objection that comes to one's mind is that the cost would be prohibitive. That this is not so is clearly proven by the article on another page. Mr. T. Commerford Martin and Mr. Putnam A. Bates, both engineers of highest standing, outline a policy by which these fast-decaying relics may be put to some use. The capital required is not large, and a dozen farmers could band together and install a co-operative electric-generating plant in the old mill, which would furnish all the electricity they would need. The average farmer would not require more than fifty horse-power, and with a co-operative plant he could obtain his power so cheaply as to make it well worth his while. We know of no better way of utilizing the smaller streams of our country, and it does not require a prophet to see in such a plan a material advancement of the farmer's condition. The first co-operative farmers' power generating station will mark a notable step in our industrial progress, and in the conservation of our natural resources.

Another Misplaced Moon

THE long list of blunders committed by distinguished literary men in writing about the moon has received a recent addition, attention to which is called in *L'Astronomie*. A work by M. Maurice Donnay, of the French Academy, contains the following passage:

"We watched the setting of the sun. It seemed as if, in the west, metals were entering into fusion, then cooling rapidly until they assumed a uniform orange tint, while *on the opposite side*, in a sky of pale and, as it were, washed-out blue, a *slender crescent moon* appeared."

Apparently there is need of more intimate intercourse between two branches of the Institut de France; viz., the Academie Francais and the Academie des Sciences. One wonders what must be M. Donnay's outlook, in general, upon the physical universe, if he has never grasped the simple relation between the moon's phases and her position with respect to the sun.

We hope that no reader of this journal needs to be told that the only kind of moon ever seen in the eastern sky near the time of sunset is one that is at or near the full.

The United States Referee Board

How It Came to be Appointed

By Ira Remsen

IN January, 1908, the writer received a letter from President Roosevelt, the essential part of which follows:

"We have reached a point in the enforcement of the Pure Food and Drugs Act where it has become necessary that some scientific questions shall be settled. For this purpose, I have decided that we shall have a Referee Board, of five members, eminent medical men or physiological chemists. The Secretary of Agriculture will certify to this Board each question upon which he desires a final determination. Only those questions will be referred to the Board concerning which there exists a serious difference of opinion among eminent authorities. . . . The Board will have full authority to make all experiments necessary to reach a decision upon the questions submitted. A secretary of the Board and other clerical help will be provided, and the expenses incident to the investigations will be paid.

"It is my desire to secure men of such high character and attainments that when the Referee Board speaks, it will be the final word on the subject so far as the United States is concerned. The questions now pressing for solution, which will probably be referred to the Board immediately, are, whether sulphur dioxide and benzoate of soda are harmful in foods. The Board will enjoy the greatest independence. The government will certify the questions and the Board will work out the answers in its own way, free from hampering influence of any kind.

"Perhaps you know one or two men who are available. If so, I ask that you will write me fully about them; also that you will ascertain if their services may be secured, all, of course, in a confidential and tentative way. Prompt action is necessary in this matter, as the Board will be appointed within a very short time."

Having taken counsel with my colleague, Dr. William H. Welch, I wrote the President, January 17th, making some suggestions. On the 21st the President wrote me as follows:

"Won't you accept the presidency or chairmanship of that committee of five? You are the very man I would most like to have on it.

"If you will accept I will later get you to come over to see me so that I may have the chance of talking the matter over at some length with you."

On the 23rd I answered thus:

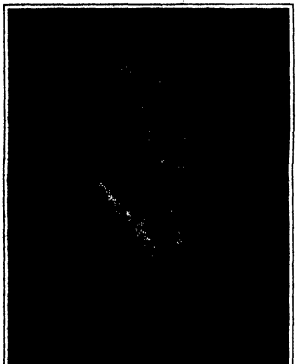
"I have given careful consideration to your suggestion and am now prepared to say that if after a conference with you, the matter should present itself to me as it now does, and I should find it possible to give the necessary time to the work, I should be strongly inclined to accept your offer.

"If you will appoint a time for an interview, I shall be glad to call on you and talk the subject over."

On the 27th I went to the White House and had a very satisfactory talk with the President. He urged me to accept the chairmanship he had offered and added, "I want you to start this work and get it under way. If you should find it too great a burden you can, of course, withdraw later." Everything he said showed clearly that the only object he had in view was to find out what the truth is as far as this might be possible. The talk between us was on the highest possible plane—refreshingly so. I accepted, and then at the President's suggestion I called on Secretary Wilson, as everything pertaining to the Pure Food and Drugs Act falls within the jurisdiction of the Department of Agriculture. My talk with the Secretary was as satisfactory as that with the President. It was clear that the Board was to be absolutely free from all external influence, that it was to work in its own way, to be, in fact, as free as the air. And let me say here, now that the Board has been in existence for over three years and has had a somewhat stormy time, that President Roosevelt and President Taft as well as Secretary Wilson have allowed us to work without the slightest interference. Our relations have, naturally, been closest with the Secretary and, as chairman, my relations with the Secretary have been particularly close, and it is a great pleasure to me to testify to his uniform courtesy and to the fine attitude he has taken toward our work from the beginning of our service to the present. Nothing could have been finer.

Now, absent the appointment of the other members of the Board. The President turned over to me all the papers in his possession bearing on this subject, and then it appeared that he had written to four or five other university presidents a letter similar to the one quoted at the beginning of this article and that these gentlemen had made some recommendations. The President said to me, "You need not be influenced by these suggestions. Select the men you think best and I will see that they are appointed." After another conference with Dr. Welch I told the President that I should like to have appointed Dr. R. H. Chittenden, director of the Sheffield Scientific School of Yale University, and professor of physiological chemistry therein; Dr. J. H. Long, professor of chemistry in the medical school of Northwestern University, Dr. C. A. Herter, professor of pharmacology and therapeutics in the College of Physicians and Surgeons (Columbia University), New York, and Dr. A. E. Taylor, professor of pathology in the University of California. The appointments were made by Secretary Wilson.

It is superfluous for me to praise these gentlemen or to say a word in defense of their character or scientific reputation. No one at all familiar with the kind of work the Board is called upon to do would venture to call in question the fitness of these members. I may perhaps be permitted to say in regard to myself that I have not engaged directly in the experimental work upon which our conclusions have been based. I have acted as chairman and exercised a general supervision. Having studied medicine before I studied chemistry, and having always been



President of Johns Hopkins University and Chairman of the United States Referee Board.

interested in the problems of physiological chemistry and pharmacology, I think I am not entirely unfitted for the work I have been called upon to do for the government. I have repeatedly suggested to my colleagues on the Board that in my opinion it would be best for me to resign, but they have persuaded me against my will not to do so. While I have become much interested in the work and am convinced that it is of value to the country, I should be glad to be relieved of the burden. In this connection, let me testify to the disinterestedness of the services of my colleagues. They have given much time to the work—in some cases without interruption from one end of the year to the other—and the compensation has been much less than would have been paid these same men for the same service. In all the discussions between the members there has never been any other desire expressed than to learn the truth and nothing but the truth. I do not see how the work could have been done more honestly.

Last winter the Board lost one of its most valuable members by death. Dr. Herter, who had for some time been in poor health, finally succumbed. To the last he kept up his interest and took part in our conferences. Weighing my words, I have no hesitation in saying that I have never known a man of higher ideals. Scientific truth was almost an obsession with him. No one could have associated with him and worked with him without being the better for it.

Another member of the Board has undermined his health by too close application to the work and, though he is on the road to recovery and we have good reason to believe that he will soon be himself again, his example is a warning to the other members.

The vacancy caused by the death of Dr. Herter has been filled by the appointment of Dr. Theobald Smith, professor of comparative pathology in Harvard University, and director of the pathological laboratory of the Massachusetts State Board of Health. Dr. Smith is a member of the board of directors of the Rockefeller Institute for Medical Research, New York, of which Board Dr. Herter was also a director. It should be said that Dr. Smith was deliberately selected by the Referee Board as the best man to fill the vacancy, and that President Taft and Secretary Wilson at once agreed.

Having thus shown how the Referee Board came into existence and under what conditions it has worked and is working, but little more is called for. The Secretary of Agriculture "certifies" the questions to the board upon which he wants an opinion. It is then the duty of the Board to answer the questions to the best of its knowledge and ability, making whatever studies may be necessary for this purpose. It has nothing whatever to do with the decisions of the Department of Agriculture and is in no wise responsible for these decisions. The department makes use as it sees fit of the reports furnished by the Board.

Finally, a few words with regard to the treatment the Board has received. Attempts have been made to discredit it in the eyes of the public. Violent attacks have been made upon it. The members have been accused of a great variety of sins of omission and commission. The law has been invoked to break the force of some of the results obtained. In general there has been much gnashing of teeth. But the Board has not been disturbed by these performances, and as long as it may continue to labor, it cannot allow itself to be disturbed by such irrelevant matters. It is important for the world that such problems as are presented to the Board should be solved and the only way they can be solved is by patient scientific investigation carried on with the sole object of discovering the truth. Scientific questions cannot be answered by the erratic acts of hysterical persons nor by political maneuvering.

Increase of Lung Capacity by Exercise

ACCORDING to careful tests made in a gymnasium in Bonn the capacity of the lungs was increased by regular exercise from 3,388 cubic centimeters or 207 cubic inches to 3,802 cubic centimeters or 232 cubic inches, an increase of 12.14 per cent. In Stuttgart the average increase was found to be from 3,833 cubic centimeters or 233 cubic inches to 4,290 cubic centimeters or 262 cubic inches, being 11.49 per cent. Among the members of the Berliner Ruder Verein (Berlin Rowing Club) the increase for the heavy crew was from 5,600 cubic centimeters or 342 cubic inches to 5,775 cubic centimeters or 352 cubic inches (3.12 per cent.), for the light crew from 4,700 cubic centimeters or 287 cubic inches to 4,875 cubic centimeters or 297 cubic inches, being at the rate of 3.72 per cent.

The Queer Argan Tree

AMONG the most remarkable trees of the world is the argan, which abounds in Southern Morocco, but is seldom seen elsewhere. A "forest" of argans has a curious scattered appearance, because the trees grow singly and far apart. They are very hairy but seldom exceed twenty feet in height. The branches put out horizontally, and begin a yard above the ground. Sheep, cattle and camels feed on the leaves, and goats will stand on their hind legs to reach them, but horses and mules refuse to touch them. The wood is very hard, and extremely useful to the natives, who make charcoal from it. The fruit resembling a large olive, is used to feed cattle and to manufacture a valuable oil. It also furnishes the principal sustenance of many of the poorer natives.

Convert Abandoned Mills into Electric Power Plants

Electricity on the Farm Made Possible by Co-operation

By T. Commerford Martin and Putnam A. Bates

IT is not a unique situation that is pictured in the accompanying photographs. A water power once in active use for mill purposes, is now abandoned because the business has moved to a city offering closer markets and better facilities for obtaining mill workers, while the farmers in the immediate vicinity, who would benefit immeasurably by the utilization of this energy were it transformed into electricity and delivered direct to their farms, allow it to run to waste. If this is the way opportunities are neglected is it any wonder that the country youth leaves for the city where life is more progressive and agreeable? The solution of the rural labor problem lies in making the farm an industrial establishment where head work as well as hand work will be in demand, where the help will find pleasure in their employment because of improved conditions that are at least as healthy and agreeable as can be found in the cities.

With a natural power at hand, such as these photographs show, a co-operative electric plant may be organized and sufficient energy developed to light the buildings and supply the power for a dozen farms. The methods by which this may be done have been known so long as to insure their practicability.

Almost all farmers could use electricity to advantage, were a satisfactory supply available, but few would have sufficient demand to justify its introduction for their particular cases *alone*. Unfortunately many men are farming without any spare resources and of them, no immediate improvements must be expected. This class seems larger than it is in reality, for the American farmer too often cares little for appearance, which accounts for the popular idea that farming must be all work and no play. There is, however, a distinct class of men in any farming section, as in the cities, who look kindly upon co-operative effort for general betterment. These are the men we must depend upon to organize our farmers' water-power electric station.

Located, as this old mill property is in the center of a farming section having a tillable soil of average fertility and surrounded with farms averaging from 300 to 500 acres each on which stock raising, dairying or grain farming is carried on we have as interesting an opportunity to practise "conservation of natural resources" as one could picture.

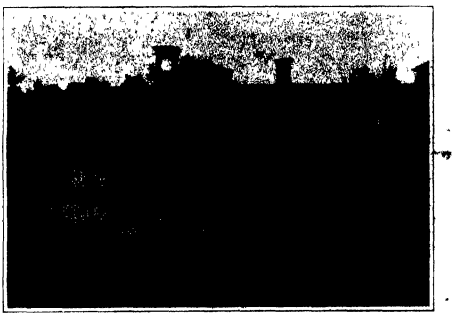
Each farmer can advantageously use some power in and about the barns, and the more electrical power he can use, the less animal or man power will be required. Besides this, electricity will be needed for lighting, a subject much neglected on the farm.

Probably an average of 25 to 50 horse-power of electrical energy could be used regularly on each of these farms, making say an aggregate of 600 horse-power in all, a plant capacity which many rural town central stations would be pleased to possess.

Why, therefore, should not farmers get together and equip this mill as a central station power plant of their own? The property has been abandoned and could be bought for very little. Some would answer this by saying that "such matters are hard to arrange amicably, and the distances of transmission introduce difficulties."



Part of dam and spillway. Very little expense would put this in shape for power service.



Old water power mill, twenty years idle. Would serve as farmers' co-operative electric power plant.

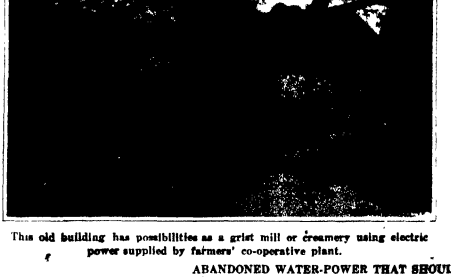
Such things are a matter of organizing only and the distance to which electric power can be transmitted is but a question of economy. The principal elements limiting this are two: the cost of power at the generating station, and the price which can be obtained for the delivered power. The difference between these two elements must cover the cost of transmission, the interest on the investment and the profit. The cost of transmission comprises the loss of power in transmission, the cost of operating, the cost of maintenance and repair. The value of the sum total of the interest, which must be paid upon the investment, and the minimum profit which is considered satisfactory, will have much weight in determining the limiting distance of transmission. A low interest rate and a low rate of profit will, therefore, be conducive to long transmission, both of which factors would naturally be low in the case of a co-operative plant. Hence, it is reasonable to conclude that with a suitably selected system of distribution the transmission question would not introduce great difficulties.

The water power here illustrated would prove quite equal to a development of 1,000 horse-power constant minimum supply, which would be an abundance for our purpose. Within a radius of ten miles, this plant as a center, a rich and only partially developed farming country lies on all sides. To reach the most extreme point of this area, therefore, with electric service and without excessive transmission loss, suggests an economical initial potential of from 6,000 to 10,000 volts.

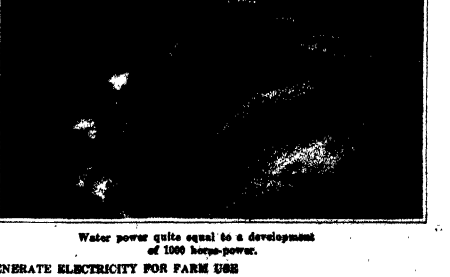
The questions of transmission and distribution line, right of way and construction are matters that should be carefully worked out and we will not attempt here to discuss these in detail, except to say that better examples are found in our western practice or in foreign countries than in the construction so carelessly erected by many eastern electric service companies, which, fortunately, is now gradually being replaced.

Where electric current is to be carried on overhead

(Continued on page 196.)



This old building has possibilities as a grist mill or creamery using electric power supplied by farmers' co-operative plant.



Water power quite equal to a development of 1000 horse-power.

ABANDONED WATER-POWER THAT SHOULD GENERATE ELECTRICITY FOR FARM USE

A Study of the Giant Airship of the Future

Its Probable Lines of Development

By Carl Dienstbach

THE very word *airship* implies a craft that will plow the air, much as a large ship plows the sea. From the beginning, the principles of marine navigation have governed the design of dirigible airships. Those who dreamt of great aerial crafts journeying from one inland port of call to another, and voyaging over housetops and forests, were unquestionably inspired by the performances of sailing vessels, and later, of giant steamships. There were difficulties which no engineer seemed able to overcome in placing aerial navigation upon the same sure footing as traveling by sea. The gas bag seemed too much like a huge, unwieldy soap bubble, which might be easily pricked and which could not weather a storm with the same facility as a great liner. The last ten years have witnessed a remarkable change in the attitude of the engineering world toward the dirigible. There is no reason, as experience has taught, why the dirigible cannot be made stout enough to weather any storm. Indeed, we have lately seen that the giant Zeppelins are far safer in the air than they are on the ground simply because of the impossibility of training two hundred men to act in harmony when it becomes necessary to guide the huge gas bag into a shed.

It soon became apparent that if the dirigible was to be speedy and was to have great endurance, it must be made larger than heretofore. The dirigibles of our day are some of them six times the size of the first airships that were considered practical. The larger they grew the safer they became in the air. And the larger they grew the more like the ocean steamship they became in their appointments. A modern Zeppelin or Parseval, with its huge railed-in engines, its board floor, its brass fittings, its comfortable chairs, is astonishingly like a well-equipped trans-Atlantic liner. Modern air travel has driven home the theoretical truth that as you make a dirigible larger it also grows smaller in a sense, a paradox which even engineers have only lately admitted.

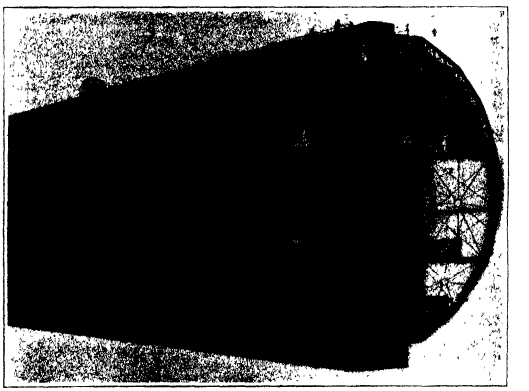
The problem of transportation consists in handling the largest load with the smallest amount of machinery possible. It is far cheaper to convey 40,000 tons in one steamer than in two, to haul a huge load by a single 425-ton locomotive than by two 250-ton locomotives. If the dirigible is ever to become a factor in the commercial transportation of cargoes it must be big. The dirigible can be increased in every direction, with a corresponding increase in lift. The aeroplane can be increased in size only in one or two planes, and then at the risk of obtaining surfaces so huge that they cannot be properly supported or easily managed.

The bigger the dirigible airship can be made the greater are its advantages. First of all, there must be considered the increased radius of action with a single charge of fuel; secondly, there is increased speed; thirdly, there is a relative diminution of gas losses; fourthly, there is the possibility of ascending to great heights, and of profiting by wind changes at different levels; fifthly, there is the assurance that rain, snow, sleet, can have no serious effect upon the structure; sixthly, there is obtained a surface so tough and stout that no sheds are required; seventhly, there is greater safety at anchor; and eighthly, there is more comfort to passengers.

First of all we must show how the size of the airship can be increased without weakening the structure or increasing its weight inordinately, and next, how and why the eight different advantages enumerated are attained, and finally, why dirigibles of large size are more safely handled near the ground than small vehicles.

A giant dirigible could be constructed, to my mind, by combining tens, and even hundreds, of dirigibles of the present size, and bundling them into the proper shape. It is obvious that this bundle can weigh no more than the sum of the weights of which it is composed. If this bundle could be propelled by the combined force of the motors of these small dirigibles, it would obviously move much faster through the air than if each small dirigible flew singly. Why? Because the placing of many dirigibles behind one another will decrease the head-on resistance, so that the surfaces behind the bow would meet with no resistance but skin friction. It is true that skin friction is nowadays considered a serious obstacle to high speed, but a bundle of dirigibles will have less skin friction than all the dirigibles flying singly, simply because in a bundle only parts of the surfaces of the outer dirigibles are exposed to the atmosphere.

The scheme could be carried out far more easily than may appear at first blush. The load in fuel, motors, propellers, rudders, and ballast, must be so distributed that each gas bag has principally one kind to carry. The dirigibles on the outer side of the bundle would alone be provided with propellers and rudders (and the rudders would be confined exclusively to the bow and stern). These propellers and rudders would be distributed over about one-third of the outer surface. One large rudder would be excessively heavy if sufficiently strong; therefore, a large number of small rudders must be installed instead.



Copyright, 1911, by Munn & Co.

Sectional view of a titanic airship with elevators to take passengers from the lower deck to the observation passageway on top of the craft.

Within the bundle will be found auxiliary machinery, dynamos, ventilators, living quarters, store rooms, and fuel tanks. Externally, the bundle will appear as a giant torpedo, with no huge car suspended below. Whatever cars there may be will be more in the nature of a continuous saloon, forming practically part of the under surface of the bundle, so as to cut down head-on resistance. Some projections there will be, such as promenade decks, bridges, observatories, wireless antennæ, and the like—all too small, however, to break the general outline. Indeed, the only projections that might cause comment (aside from the lifting horizontal aeroplane rudders) are the hundreds of propellers studding the entire surface, ranged in rows around the entire outer surface in spirals of small pitch, not unlike the rifling that runs within the bore of a modern gun. Such a spiral arrangement avoids interference of many propellers with one another, so that each may work in undisturbed air. Only the bottom surface of the bundle, to which the saloon is attached, is free from propellers.

In principle, these propellers are like those which Zeppelin has so effectively employed. They will be mounted as he mounts his, except that those near the bow and stern are to be swiveled so that they can be swung in any direction to exert a steering effect, and to assist the rudders, especially in landing.

Horizontal rudders of the multi-plane type used by Zeppelin are distributed along the flanks of this huge dirigible. Vertical rudders of the same type are clustered around bow and stern.

Most important of all are the internal arrangements of this mammoth airship. The Zeppelin compartment system of storing gas is developed to the utmost. There will be hundreds of gas cells, many "inside cars" or small gas-tight compartments to accommodate motors, machinery, stores and passengers. Special ventilating apparatus will be required to keep the air free from hydrogen so as to prevent the formation of an explosive mixture. The machinery must be so distributed that its weight will be carried by certain groups of gas cells. The walls of the gas cells are designed to form tunnels so as to provide passageways between the "inside cars." Piping and electric wiring (suitably protected) runs through the whole interior structure.

In more or less close proximity to the outer skin the gas cells are traversed by shafting from the many motors, and by transmission gears to operate the many rudders.

It goes almost without saying that the rigid system will be used in the construction of this aircraft. Theoretically, the entire complicated fabric might be held without buckling by balloonettes kept distended by blowers. In practice, however, it will be difficult indeed to use any but the rigid system. There is this point gained, however, that with this "honeycomb system" rigid construction is less wasteful of weight than in a Zeppelin. The frame does not need to be so strong, as the buoyancy of the gas itself braces the whole structure, for the bracing effect which in a spherical balloon the gas exerts only on the upper part of the envelope, is here extended over the entire structure. Nevertheless a dirigible built along these lines is subject to certain limitations as regards size. The first point which has to be considered is the necessity of keeping the balloon right side up. This forbids us to distribute the weight quite uniformly throughout the whole structure, for of course there must be an excess of weight at the bottom. This requirement introduces an element of weakness in very large dirigibles. We have here a very good illustration of a general principle, namely, that as a structure is increased in size its weight and strength do not increase in the same proportion. For even if we only consider the ropes by which the balancing weight is attached to the envelope, as the size of the airship is increased, these ropes must be made both thicker and longer. Now their strength is proportioned to the thickness, their weight, on the other hand, to the product of their thickness into their length.

Another limiting factor is found in the internal stresses set up during any sudden acceleration or retardation. It has been tacitly assumed that each gas cell is proportioned only to take care of the inertia or momentum of the load which it has itself to carry. As a matter of fact, it must, in addition to this, bear the cumulative strain of the loads of the entire row of cells in front or behind, as the case may be. This difficulty, however, is not as serious as at first sight appears, for the mass of the outer envelope and the inner framing is so large in proportion to the surface, that very abrupt motions of the ship are practically out of the question. A third limiting factor which suggests itself, would seem to lie in the fact that the thrusts of hundreds of propellers would have to be borne entirely by a single prow, which would either be unable to sustain this stress, or else would have to be made stronger and heavier than would correspond to the individual dirigibles of which we have imagined our bundle to be composed. As a matter of fact this objection also is fallacious, and the thrust of the numerous propellers is not really cumulative, for the resistance against rapid flight arises chiefly from skin friction. Hence the thrust of each propeller is taken up mostly just at the point where it is applied—along the flanks. Nevertheless, such limiting factors as these do unquestionably preclude an indefinite increase in

size of the balloon. Yet the dimensions which are permissible are almost incredibly large. Moreover, a great advantage can be gained by neutralizing the crushing effect of any local wind pressure. This can be effected by the simple expedient of providing suitable vents through which the air pressure produced by the wind finds its way instantly into the interior of the structure. In this way the pressure against the prow in rapid flight is taken up quite as much by the rearmost internal gas cells as by the forward ones. The pressure from within is rendered equal to the pressure from outside. (The small and flimsily constructed captive balloons known in Germany as "kite balloons" are built on this plan and have weathered hurricanes that tore them from their cables but were powerless to crush them.)

The vents should be well proportioned and provided with valves, as it might be found best to limit the pressure of the wind, with the result that the strain on the side of the structure would be eliminated in spite of the hundreds of revolving propellers. The thrust of the air resistance in front is neutralized (in the material) by the pull of the suction in the rear. Thus, for instance, we may have a pressure of ten pounds per square foot upon the outside of the prow; the vents might provide a pressure of five pounds per square foot on the inside, leaving five pounds per square foot to be taken up by the material along the sides. But the vents also provide five pounds per square foot on the inside of the stern, and this pressure is not opposed by any counter force from outside, but on the contrary is assisted by a suction. This results in a pull along the sides in the material, which exactly compensates for and eliminates the compression.

As it has been conclusively shown how that the "bundle" of balloons moves faster than the component dirigibles singly, the radius of action, or the fuel supply carried, may be much increased by making the power plant weaker than the sum of the component dirigibles' aggregate power. A further decrease in power (without much lowering the speed) and in the load carried, will secure the additional advantage that the ship may be floated with partially inflated gas cells, and, supported by its aeroplane rudders, allowed to ascend to the highest levels.

The larger the volume of the dirigible, the smaller is its surface in proportion to its lift, or to the gas carried. If the air space between the outer skin or envelope and the interior gas bags, which has proved so useful in Zeppelin airships, is introduced into the design of a mammoth dirigible, it will completely eliminate all troubles arising from variations in the lifting power caused by a change in temperature under the influence of the sun's rays, or of darkness or shadows. Furthermore, it is obvious that the adventitious load which may collect upon a dirigible in the form of rain, snow or sleet, or ice, is proportional to the surface area. If this area is small as compared with the lift of the balloon, the effect of such unwelcome ballast is correspondingly reduced, and the mammoth dirigible approaches in this respect the sea-going vessel, which is practically quite unaffected under similar conditions. The numerous propellers will incidentally serve a useful function by blowing a strong blast of air along the surface of the car, whereby any snow or rain will be swept off. An obvious improvement which suggests itself would be to heat the air space around the gas bags with the exhaust from the motors, thus preventing ice from forming upon the outer envelope. By flushing this space with hot exhaust gas, or cool air, as the case may be, the balloon gas within may be rendered entirely independent of outside influences. The volume of the air space is comparatively very small, and there is enough exhaust to inflate it in a few minutes. The task is much facilitated through the fact that all the motors are in comparatively close proximity to the outer envelope, and are distributed more or less evenly over the whole structure. This device should be of great assistance in adding to the lifting power of the mammoth dirigible. For it will keep the temperature of the gas much above that of the frigid air at an altitude of three miles, for example. It is, of course, well understood that this circumstance increases the buoyancy.

One objection which perhaps arises in the reader's mind, is the danger from fire. As a matter of fact, the problem of guarding against this is no greater than that daily faced in coal mines. The Davy wire gauze screen must be used to the fullest extent of its possibilities. Its weight need be but small. First and foremost the carburetors must be inclosed in absolutely proof gauze baskets. In addition to this the entire engine room should be similarly protected. All electric insulations must be as perfect as those near the powder magazine of a warship. Exhaust tubes must be water-jacketed, asbestos-lined and inclosed in wire gauze, and the same applies to the mufflers. The gasoline tanks should be placed at the very core of the ship, far from the engines, and the fuel should be forced under pressure through slender but strong tubes of annealed copper, which would stand any vibration or shock. All joints must be welded by the autogenous process. These tubes run through small tunnels continuously flushed by a current of fresh air. The principal safeguard against fire is the elaborate ventilation system which instantly dissipates any escaping gas or gasoline fumes at any portion of the interior. The weight of these safety devices is but trifling. In point of ventilation the airship has this great advantage over the ship traveling by water, that it receives the relative wind always from the same quarter and with a never lagging force while under way. The mechanical blowers receiving the air (from the vents) already partially compressed are thus relieved of a considerable portion of their work. When the balloon is stationary the main motors become available for driving the ventilating engines. At the moorings in the harbor compressed air for the safety ventilation is taken from fixed mains through a flexible hose. A great air harbor of the future will include a blower plant similar to that of a foundry.

The complicated system for the circulation of water, air, steam and for the distribution of electricity, so familiar on large ocean vessels of our day, is not only a convenience, but becomes a vital necessity in the dirigible of the future. This safety ventilation, on the other hand, tends to increase the gas losses. If the entire structure were one great gas space, the volume of gas would be so great in proportion to the surface, and the outer envelope so thick, that the loss would be insignificant. The captive balloon at the Paris Exposition, with 25,000 cubic meters capacity, has proved this. But in the practical airship here described, the proportion of the total surface of the gas cells to their volume is just as great as for a single one of the individual cells of which it is composed, nor are the walls any thicker. However, the gas loss by slow filtration through the envelope is even in the balloons of the present day more than compensated for by reduction in fuel weight, and as a matter of fact, troublesome gas losses occur only through expansion by ascension or under the influence of the sun's rays. This last source of loss is completely overcome in the dirigible of the future. In order to avoid having to blow off gas when the fuel supply (ballast) runs low, the gas itself should be used as fuel, and not run to waste.

The cost of housing a very large airship would be a serious difficulty. But there is no reason why a balloon should not be moored in the open, provided that two conditions were complied with, both of which are fulfilled by the mammoth dirigible. The first requirement is sufficient toughness of the outer envelope, so that neither rain nor snow nor sun could harm it. The second condition is sufficient strength of structure to withstand the pressure of a gale. (As the air offers nowhere a real harbor in the same sense as a sheet of water, but only open anchorages, in an excessively severe storm an airship must simply take the same steps as would be adopted by a steamer in the open sea—raise anchor and get up steam.) The second condition is obviously fulfilled if the normal speed of the ship is equal to that of a storm. The anchor cable must of course be attached to the bow, in such way that the entire frame acts toward tension stresses as an elongation of a cable. In a severe hurricane propellers can be started to ease the strain on the cable. The strength of the structure in proportion to its bow area and the vent system provide ample margins of safety. Absolute safety will be secured by anchoring a ship to a high tower, around which it would swing freely as a weather vane. But the Zeppelin method of holding the bow close to the ground and allowing the stern to float and swing, relying on the jamming of the wind between the hull and the ground to prevent a fatal collision with the ground, also holds great promise and has the advantage of simplicity. It certainly has proved effective in very high winds. After leaving the dockyards a mammoth dirigible must remain afloat as steadily as a ship in order to be manageable. This problem presents no difficulty at the present time, being solved in the Parseval airships by the daily injection of small quantities of fresh gas. If this is effective in an airship with a single gas space, it would be even more so in a multi-cellular ship, in which the gas in the cells may be completely renewed by emptying and inflating cells alternately without decreasing the flotation more than can be readily allowed for in the harbor. In the same way entire gas cells may be removed and new ones inserted while the ship remains afloat. It may even be possible to devise a method for eliminating the air from deteriorated gas, extracting the latter from the cells and returning it to them regenerated.

A mammoth dirigible provides all the comforts of a steamer. Staterooms would be located in the interior, dining saloons, kitchens, stores, etc., near the bottom, promenade decks on the top. It is interesting to note that elevators weigh less than stairs, especially those built on the plan of modified rope ladders. Furthermore, monorails with light cradle frames running over them weigh less than passageways with walking floors. A new system of rapid intercommunication must be introduced on board the dirigible of the future to save weight and insure comfort. Incidentally it would prevent the sudden shifting toward one point of the weight of many passengers. No doubt the mammoth dirigible will prove weaker if it collides with the ground than a dirigible of to-day. But similar objections hold in the case of ships on the water, and still their size is increasing at a rate which makes us smile at the "Great Eastern" of years ago. A rowboat is but little damaged by a collision. If the "Titanic" should drift at slow speed against a rock, its steel plates would crumble like paper. If the parts of a steamer are stronger than those of a dirigible, the total weight of a steamer, which determines the crushing force, is also greater in the same proportion. Ships are placed under much the same circumstances on the water and in the air, and in either case must be jealously guarded against any possible collision. In the case of a dirigible, the danger is greatest while it is being handled near the ground, but the mammoth dirigible, after it is once launched from the dockyard shed (in absolutely quiet air, of course, as at the recent launching of the English naval dirigible), does not need to be handled near the ground because it does not enter a shed. It may be moored to a tower or upon a broad unobstructed plain by its own engine power, which is great enough to control very heavy winds. This means that with its propellers the ship can be held motionless against any wind. With the aid of the rudders even sudden gusts may be resisted, inasmuch as they cannot produce any jerky motions in a body of such large bulk. (To anchor in a severe storm is as inadvisable as it would be on the water—storms must be outridden.) The operation of landing on a plain would involve some very nice work of the horizontal rudders while the ship is driven energetically with reversed engines. The bow is dipped down toward the ground, anchor is cast, and the engines are reversed to their normal motion to ease the jerk on the anchor. Then the engines are reversed again and at the same time the anchor is hauled in. In this way the anchor is made to bite the ground so firmly that it will still hold even after the cable has been shortened from 20 to 30 feet (this terminal portion of the cable being made twice as strong as the rest). The propellers are kept revolving until the anchor has been permanently secured. A flexible "gang plank" is dropped to the ground from the bow, while the ship's stern remains floating high in the air. Very similar maneuvering has been successfully used on the Zeppelins. Keeping some of the propellers revolving with reversed motors is of course an excellent way of guarding against any collision of the bow with the ground, even in heavy and irregular gusts, while thus anchored.

If the airship is to be made fast to a tower it must be skillfully brought near the top of the tower, best by drifting past with the wind, at a moment when the wind is fairly steady. Several attempts may be necessary before success is attained. In this case also it may be a good plan to keep some of the propellers revolving in the reverse direction.

Fantastic as this mental picture of the giant airship of the future may appear to us with our present notions of aerial navigation, when we think of our sky scrapers and the 50,000-ton leviathans plying the sea, it appears that the picture here drawn is well in accord with the modern tendency, and in fact it is to be expected that the 1,000-foot airship will make its appearance before very long.

The Opium Problem in Parts of China

SOME unexpected results are found from the movement against the production of opium in China. In the Yunnan, one of the provinces where opium was produced in large quantities and at a low price and where a great deal of it was consumed, it appears that the poppy is no longer cultivated, owing to the recent measures, and the poppy fields have quite disappeared, according to the statements made by Drs. Talbot and Rigaud. However, this has had a disastrous effect on the honey culture of the region. In fact, the honey from Yunnan was renowned for its quality, but as the bees find no more flowers, the production of honey is stopped as well. The new crops which replace the poppy, such as wheat or peas, are not such as will give a honey yield as well. On another side of the question, it appears that the habits of the population are not suppressed by the present legislation, as some supposed would be the case, but according to Dr. Talbot, opium-smoking is again on the increase.

Correspondence

[The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.]

Audibility of the Aurora

To the Editor of the SCIENTIFIC AMERICAN:

If your paper is interested in the above question, you can easily set Prof. Trombolt right by sending one of your staff to St. John, N. B., or Halifax, N. S., during the fall months, or better in the early winter, and he will then hear the sounds from the aurora, and perhaps it is possible to phonograph them.

I have heard those sounds thousands of times, particularly on very cold and clear nights, while living in St. John thirty to forty years ago.

They sound like the swishing of switches through the air, and at times like the detonations of small fire crackers; at other times they sound like distant musketry, as if firing away from the heaven.

The sounds, as I remember them, do not appear unless the aurora is moving, which happens often enough for observation.

New York city. R. FLAHERTY.

A Plan to Protect the Poor Inventor

To the Editor of the SCIENTIFIC AMERICAN

As I believe that a meeting of the International Congress of the Union for the Protection of Industrial Property is soon to take place, I take the liberty to submit some suggestions that I trust will be useful and worthy of consideration.

It is a well-known opinion among a majority of manufacturers and inventors of limited or liberal means, that the term of a patent is at present too short. It is also well known that the protection as to right of priority of invention is not as perfect as it should be. The manufacturer, when he files an application for a patent, has the capital necessary to put the article on the market and to fight through the courts not only the infringers but such patents as are in the way, even though they do not fully infringe. The inventor of limited means, at such times, lacks perhaps the experienced experts of the manufacturers that are ever ready to give any testimony in litigation to prove priority of invention or other facts; and at the best all that said inventor can secure, with his more honest but poorly defended evidence, is of very little importance and hardly satisfactory.

To remedy the above two conditions I suggest:

1. That the term of a patent be extended to twenty years.

2. That the first and final patent fees be $20 each.

3. That each patent thus issued shall be renewable for ten more years upon the payment of a tax of $200.

4. That a second renewal be allowed to each patent upon the payment of a tax of $300.

5. That *each* inventor, to prove his priority of invention, be allowed to prepare his own rough sketches in secret, as the development of the invention progresses, said secret sketches to be presented for sealing to a judge or other high official in the district in which the inventor is located at the time.

6. That the sealing before the judge or official be made under oath after the payment of a tax of $1, the sealing being of such a prescribed character that it will not disclose the nature of the invention at the time, and will prevent interference with the contents of the package after sealing, and that will also indicate the date of sealing, the district where the sealing took place, and the name and position of the official sealing said secret sketches, which may be identified hereafter by the term "Priority Proofs."

7. That the inventor be allowed the option of holding said priority proofs or of filing them in a special department in the Patent Office.

8. That said priority proofs shall not be examinable, when filed, until the time of the filing of the formal patent application, and then only after a request to that effect by the applicant.

9. That an inventor be allowed to secure as many such priority proofs as he may deem advisable.

10. That the presentation of the earliest or of all of said priority proofs, secured for one invention, under the proper seals, shall be considered as *prima facie* evidence in any dispute of priority or technicality arising during the examination or litigation of any patent case.

It can be seen from the above that if A has an invention fairly well defined in its form, but still subject to a series of developments, he can under oath secure, without disclosing his invention, a priority proof under the seal, date and signature of a judge or other high official, and thereafter follow the development of his invention for a period of time until it is ready for the formal filing at the Patent Office, the inventor feeling all this time his work is under protection of priority.

This will also help many inventors that cannot afford at the time the expenses of a patent application, giving them the opportunity to save or raise such moneys after they have sealed their priority proofs and assured their inventive rights.

The *priority proofs* are not examinable, and, except for the filing, they will cause no extra work to the Patent Office, until requested by an applicant filing a formal patent application.

The priority proofs will tend to eliminate the abuses of expert testimony, at present experienced in certain patent litigations.

Another point I wish to call to your attention is the lack of patent protection accorded Americans in foreign countries under their present laws.

While we issue a patent for seventeen years without yearly taxes except the initial fees of $35, most of the foreign countries issue patents for fifteen years for an initial fee like our own, but subject to a yearly tax on each patent as well as working clause.

Both of the above features are objectionable to the interests of the American inventor and manufacturer, and there is no reason why we should allow the privileges under our laws to the foreign patentees whose countries refuse to allow similar privileges to our inventors.

The loss to our ingenuities and industries is pronounced. An inventor having a valuable invention, patents the same abroad. In trying to sell it, when he cannot manufacture it himself, he experiences much delay at the hands of certain manufacturers, with the result that the working time limit comes right upon him. After such time, his patent being belittled in value, can be and is fought, and declared null and void, and thereafter every manufacturer abroad reaps a harvest upon the hard labors of American ingenuity.

In consequence, the American finds it difficult to control many an article in the foreign markets, and very often hard to compete with similar productions of such market.

Even manufacturers that, for certain reasons, have found it impossible to manufacture their patented articles abroad, have had their patents abrogated and lost considerably thereby.

At the same time, a foreign manufacturer can secure a patent in this country under the liberal system, manufacture the article in his own country, at low cost of labor, and importing it here and selling it at a lower cost and better profit than in his own country.

This also explains, in part, why a number of the foreign countries are not so often subject to the periodical industrial retardations that are so current in this country.

The inventor with limited means possibly finds himself, after delayed negotiations or litigations with foreign manufacturers, unable to pay the taxes, and the loss of the patent is the result.

It would be a very patriotic and conservative policy on your part to urge legislation to the effect:

1. That the citizens of a foreign country, not residing in the United States, and whose country issues patents to American citizens under the time limit clause and yearly tax clause, shall be able to receive and hold their patent rights in this country only upon working their invention in this country within three years from the time of the issue of the patent and upon the payment of a yearly tax of $20, beginning from the second year.

2. That upon the failure of the patentee to work his invention within the prescribed limit of time, his patent shall be open to contestation and annulment.

3. That upon the non-payment of the yearly tax, said patent shall be declared null and void.

4. That the citizens of such foreign countries as accord to the American inventor the same privileges that are accorded by the United States laws to its own citizens, shall be exempt from the working clause and the yearly taxation.

These points when brought to the attention of the foreign delegates at the coming convention may prompt them to suggest or formulate modifications in their laws as to the Union of Industrial Property clauses that would be more favorable to the American inventor and manufacturer.

The foreign countries can easily suspend the working clauses and yearly taxes, and if they need the money from such taxes they can make it up by increasing the initial filing fees.

They can easily realize that by removing the above objectionable clauses from their laws they will encourage invention to such an extent that the initial fees of the increased number of patent applications will more than compensate for the change.

A great majority of the American inventors would, under the new conditions, file foreign applications, while at present they do not care to do so because of the existing uncertainties.

I trust that these suggestions will receive the approval of a great many inventors, and therefore will attempt to give the American inventive public an opportunity to take up the subject and debate upon the merits and demerits of said suggestions.

It is the cause of the inventor with limited means that must be progressed, for they are the pioneers in all great things, as is evidenced by the manufacturers looking to them for meritorious inventions more than to their own experimental staffs.

The time is now ripe for such a move on your part, and I therefore urge you to give due attention to the matter, presented, as it is, as a conclusion of views given by inventors, manufacturers, and attorneys.

New York city H B T

Electric Fans for the Sick

To the Editor of the SCIENTIFIC AMERICAN.

A subscriber to your paper has written us, calling our attention to a short article in your issue of July 22nd entitled "Electric Fans for the Sick," the same referring to the practice of The Electric Supply Company at DeKalb, Ills. This gentleman it seems, had heard of the order issued to all of the electric properties under the control and management of H. M. Byllesby & Co. early in July, directing that electric fan service be furnished free to all invalids who were unable to pay for the service, upon presentation of the proper certificate from attending physician. This order meant that in 106 cities and towns in the West, Middle West and South, any indigent sick person might obtain fan service during the hot months absolutely free, the local company not only providing the fan, but extending the service lines and temporary interior wiring where necessary, and furnishing current. This action has resulted in a great deal of favorable comment both by press and public, and in nearly every city from six to eight fans were immediately placed in commission under the terms mentioned.

The idea so far as we can learn originated with the electric light and power company at Rochester, New York. As soon as Mr. Arthur S. Huey, vice-president of H. M. Byllesby & Co., heard of it he immediately issued the order described above, which directly reaches invalids in a total population of nearly one million people.

H. M. BYLLESBY & CO.
By W. H. HODGE, Publicity Manager.

The Postal Aeroplane

REPORTS come from England and France that the official postal aeroplane for the rapid transport of mail matter is soon to become an actual reality. On August 13th Pierre Vedrines, the veteran aviator, winner of the prize for his recent notable aerial trip from Paris, France, to Madrid, Spain, made one of ten flights to demonstrate the possibility of an aero mail service. This flight was most successful. He left Issy-les-Moulineaux near Paris with mail aboard at 5.07 P. M. and reached Deauville, near Trouville, 112 miles from Issy, at 6.50 P. M., or one hour and forty three minutes, or at the rate of a trifle over sixty five miles an hour. The time of the fast express train going the same distance is 3 hours and 12 minutes, or 1 hour and 19 minutes longer.

On the way Vedrines dropped letter packages at Mantes-sur-Seine, Evreux and Lisieux. It is said he was paid five hundred dollars for the flight, which would average a trifle less than $5 per mile.

In London the Post Office Department is making preparations for the early inauguration of a special aerial postal service to be carried on between London and Windsor a distance of twenty-one miles. Special aerial post boxes are to be placed in public places, in which letters for this service must be deposited the same as in ordinary boxes. Collections by carriers will be made in the usual way and deposited in a central location, from which the aeroplane will depart. There the mail will be placed in sealed letter bags and the latter strapped on to the aeroplane. The flight to Windsor will occupy about half an hour. From Windsor the mail will be forwarded by train to its intended destination. King George has given permission for space in Windsor Park to try out this experiment, which is to last a week and perhaps longer.

The time is now at hand when it would be in the line of progress for congress to make appropriations for an experimental aerial postal service between two cities, as for example between New York city and Philadelphia, providing for hourly flights each way. Operating at a speed maintained by Vedrines in the Paris experiment, a letter could be sent from New York in the morning to Philadelphia and the sender receive an answer in the afternoon.

Abstracts from Current Periodicals

Phases of Science as Other Editors See Them

The Man of Glacial Europe

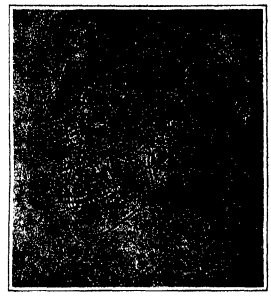
THE man who can point to a line of distinguished ancestors from whom he is *descended*, usually sees in the fact an object of self gratification. It would seem more logical if he took pride in showing that he has *ascended* from his progenitors, though perhaps he might hesitate to decorate the walls of his dwelling with the portraits of such rude forbears as are shown in our accompanying illustrations Dr Keith writing for the *Illustrated London News*, presents as follows the most modern views with regard to the earliest traces discovered of man's habitation upon this earth

In recent years our knowledge of the human in habitants of Europe during the Glacial period has *increased rapidly* It is over fifty years since the *first* trace of him was found at Neanderthal, in South Ger many, before that, although it is only recently we have got to know the fact, he had been found in Gibraltar the skull then found, on the whole the most perfect yet discovered, is in the Museum of the Royal College of Surgeons of England In recent years three wonderfully instructive skeletons have been found in the southwest of France, in the valley of the Dordogne, and have attracted much attention Remains of the Neanderthal man have also been found in Belgium—the famous skulls of Spy—and in the southeast of Europe—at Krapina, in Croatia And now, thanks to the researches of the Société Jersiaise, remains of this race have been found in Jersey In a cave in the cliffs of St Brelade's Bay, on the south coast of the island, his hearths, his characteristic flint implements, and his unmistakable teeth have been discovered

A recently rich man must find occasionally, when proper investigations are made, that his remote an cestors are infinitely older and more respectable than he had formerly reason to believe It is becoming more and more apparent that this is the case as regards modern man The discovery at Galley Hill showed that our modern type was in existence in England soon after the glacial period had vanished—a period of several hundred thousands of years Glacial man is much older His lower jaw, with a complete set of teeth, was found four years ago near Heidelberg in a stratum which lay eighty-seven feet from the surface, and was mixed with remains of extinct animals The age of the Heidelberg individual has been assigned to one of the first temperate interludes which broke the *prolonged period of intense cold* in Europe At so early a period—one which makes the age of the Galley Hill man a comparatively recent one —we expected, on the Darwinian theory, to find man in a transition stage, a man-ape or ape-man—a pithecanthropus That conception has dominated the artist when he has sought to reproduce the form of the Glacial European—or, to use a more strict geological term, Pleistocene man A little over two years ago, a graphic reconstruction of the man just then discovered at La Chapelle-aux-Saints appeared in these pages The anthropologist and artist have pictured his mouth, his teeth, his nose—indeed, the whole of the lower part of his face—as very similar to the same parts in the gorilla In representing his attitude, his posture, his feet, legs, arms, and skin, they have drawn largely on the same animal

When, however a *careful study* has been made of his skull, his teeth, and the bones of his body, it becomes very evident that there was very little more of the ape in the Neanderthal type of man than in his modern representative He had certainly, as may be seen from the drawing by Mr Forestier, very striking peculiarities His face was long, wide and heavy, with rather massive jaws but his teeth, as regards their crowns were no bigger or different in shape and size than we see now in many primitive native races The eye-sockets were loose, and the eyes seemed deeply set owing to the great over-hanging beetling forehead, and the nose was wide prominent, large, quite unlike the same organ in negroid races His brain was not small, in most cases it appears to have been above the average of modern Europeans Some of his worked flints show great dexterity His arms and hands were *muscular* roughly molded and strong but used, if one may judge from their shape, much in the same way as we use ours He stood a little over five feet in height There are no features in the bones of the lower limbs to suggest a posture or a manner of walking materially different from those of modern man

His mouth and tongue were larger than ours, and the impressions on the lower jaw for the muscles



The "modern" man of half a million years ago; his skull and his features.

concerned in speech differ so markedly from those seen on the mandibles of modern man that we must conclude that, if speech were present, then it must have been of a primitive nature and different from the vocal articulation of modern man

Most of the remains of the Neanderthal man, like



"The man of from one to two hundred thousand years ago."

According to Mr R. S Lull, an ingenious scientific reconstruction.

those recently found in Jersey, have been unearthed *from the floors of caves*, so that we have no means of judging what period of time may have elapsed since the remains were deposited there. In the case of the Heidelberg man, however, we have some grounds, and from the depth and nature there of the strata some



Declared to be a misconception.

A reconstruction (of two years ago) of the man of La Chapelle-aux-Saints

OUR RUDE FORBEARS

Photographs by courtesy of the *Illustrated London News*.

estimate can be formed of the extreme antiquity of the Neanderthal race. Layer on layer has been laid down by the action of running fresh water, until the deposit in which the Heidelberg man was embedded lay eighty-seven feet below the surface. The rate of deposit we have as yet no accurate means of estimating, but few geologists would assign a period of less than 500,000 years, and most would give a larger figure.

It is becoming thus apparent that not only is modern man of great antiquity, but the earlier stages in the evolution of man have been passed through at a much earlier period of the earth's history than we had formerly any conception of It must be remembered, too, that the Glacial period extended through hundreds of thousands of years; so far as we know, the Neanderthal type persisted throughout the whole of that time in Europe. We must expect, however, to find much individual variation in so vast a period of time; race must have succeeded race, as has ever been the case among living things Presently we shall be able to recognize the older and more primitive from the later and more evolved races of Neanderthal Man

Poisoning by Illuminating Gas

THE French journal *L'Electricien* has been gathering some interesting statistics in regard to cases of poisoning by illuminating gas It appears that for several years past the number of such cases has been rapidly increasing In New York alone there were nearly two thousand cases in one year, many of them fatal The *reason for this* increase is traced to the change in the composition of the gas used for illumination, especially with respect to the amount of carbon-monoxide present Different kinds of gas contain different amounts of this gas, as shown by the following table:

	Percentage of CO.
Coal gas	6 6
Oil gas	10 0
Water gas	40 0

From these figures it is seen that coal gas is the least harmful kind, and that water gas—made by passing steam through red-hot coke—is the most dangerous. For the purpose of saving the cost—or of increasing the profits—manufacturers have from time to time mixed varying proportions of water gas with coal or petroleum gas As the water gas is odorless its presence is not readily detected, and when it is mixed with coal or oil gas a large quantity of the mixture may escape into the air without being noticed In many communities and states the use of water gas is prohibited for this reason

Frost Cartridges

IN the *Monthly Weather Review*, April, 1911, Professor A. G McAdie describes a new device for protecting fruit trees from frost; viz., the "frost cartridge." Just as orchard heaters marked a distinct advance over the old-style open fires, which warmed up all out of doors, so it is believed that these cartridges, which can be used in close proximity to the fruit to be protected, will prove to be more effective and economical than heaters placed on the ground.

The cartridge consists of a cylindrical tube of heavy cardboard or other suitable, slow-burning material, which is filled with a mixture of crude oil, gravel and sawdust. Two stoppers are provided to close the ends of the tube. When filled, the cartridge is suspended by a wire about three feet below the fruit. When used, the stoppers are removed and a torch is applied to small amounts of cotton waste, which have been soaked in kerosene and placed at the ends of the cartridge. A cartridge case two feet long and one and a half inches in diameter will burn about two hours. If the combustion is good there will be nothing left but the gravel and a small residue of charred cardboard

The tubes may be filled during the afternoon hours, although it is found that they will hold the oil without leakage and without softening for several days.

There are two objections to the use of this device in its present stage of development: (1) the danger of fire from the burning ends, and (2) the large amount of solid matter on a portion of which is deposited upon the fruit. Experiments are in progress looking to the atomization of the crude oil so that combustion will be improved.

Stress in Aeroplanes in Curvilinear and Fancy Flight

The Mechanical Significance of Aerial Antics

By A. F. Zahm

Of the many dangers encountered in aeroplaning one of the most clearly defined, as also one of the most seductive, results from fancy flying—from wheeling round sharp horizontal curves, from conic spiraling, from cascading, swooping and undulating in vertical plane curves. The danger is particularly alluring to reckless young aviators engaged in public exhibitions, partly because they do not adequately appreciate the risk, partly because of the intrinsic charm and delight of such varied motion, and largely no doubt because of the liberal applause received from the admiring throng and the reciprocal desire to please that throng, too captivated by the fantastic grace of curvilinear flight, and by the bravery and abandon of the impetuous airman, to realize the hazardous nature of his fascinating maneuvers. Singularly enough the exact magnitude of such hazard, or say more accurately, the increased stress in the machine, though beyond the approximate guess of the practical aviator, is capable of nice computation in terms of the speed and curvature of flight. It seems important therefore to place the computations in ready form before all persons concerned in such maneuvers—the reckless pilot, perhaps with a wife or family dependent upon him, the applauding spectators who encourage his daring, and the cautious manager or company that, for reasons manifold and obvious, wishes to avoid disaster both to the man and to the machine.

During his recent exhibition in Washington, Mr. Glenn H. Curtiss found difficulty in restraining one of his intrepid young aviators from executing various hair-raising maneuvers. The boy loved to frolic in the air like a swallow or bird of prey, to the joy of a light-hearted throng, except possibly his wife and friends. He would plunge from a great elevation to acquire the utmost speed, then suddenly rebound and shoot far aloft. He would undulate about the field like a galloping horse, or an impetuous torrent vaulting over rocks or a rugged bed. He would bank his machine till its wings stood apparently vertical. Mr. Curtiss solemnly warned the aviator and earnestly restrained him, pointing out the danger of sweeping sharp curves at high speed. He then turned to me and expressed the wish that some one would determine exactly the amount of the added stress in curvilinear flight. The following paragraphs embody my response to his wish. With the death of St. Croix Johnstone fresh in the public mind, let us hope that they may be taken to heart by pilots who strive to please the multitude.

When a body pursues a curvilinear path in space the centripetal force urging it at any instant may be expressed by the equation

$$F_n = m\ V^2/R \text{ (absolute units)}$$

$$= \frac{m}{g} V^2/R \text{ (gravitational units)}$$

in which F_n is the centripetal force, m the mass of the body, V its velocity and R the instantaneous radius of curvature of the path pursued by its center of mass. Since the mass may be regarded as constant for any short period, the equation may be verbally expressed by this simple law: the centripetal force varies directly as the square of the velocity of flight and inversely as the instantaneous radius of curvature of the path.

In applying the above equation to compute the stress in an aeroplane of given mass m, we may assume a series of values for V and R, compute the corresponding values for F_n, and tabulate the results for reference. In such manner the following table was obtained. It may be remarked that, on substituting in the equation, V has been taken as so many miles an hour, R as feet, and g as 32 miles an hour, for convenience, this being 32.1 feet per second.

This table shows at a glance the centripetal force acting on an aeroplane, as a fractional part of the gravitational force or weight, of the machine and load. If, for example, the flier is rounding a curve of 400 feet radius, at 60 miles per hour, the centripetal force is 0.55 of the total weight. At the excessively high speed of 100 miles an hour and the extremely short radius of 100 feet the centripetal force would be 4.55 times the weight of the moving mass. The pilot would then feel heavier on his seat than he would sitting still with a man of his own weight on either shoulder. Again for speeds below 40 miles an hour, and radii of curvature above 200 feet, the centripetal force is below one-third of the weight.

Centripetal Force on an Aeroplane for Various Speeds and Curvatures of Flight

Velocity, V, of the Aeroplane	Radius of Curvature, R				
	Ft. 100	Ft. 200.	Ft. 300	Ft. 400	Ft. 500
Miles per Hour	Weight	Weight	Weight	Weight	Weight
30	0.41	0.20	0.14	0.10	0.08
40	0.73	0.36	0.24	0.18	0.15
50	1.14	0.57	0.38	0.28	0.23
60	1.64	0.82	0.55	0.41	0.33
70	2.23	1.11	0.74	0.56	0.45
80	2.91	1.45	0.97	0.73	0.58
90	3.68	1.84	1.23	0.92	0.74
100	4.55	2.27	1.52	1.14	0.91

The entire straining force on the aeroplane in horizontal flight being substantially the resultant of the total weight and the centripetal force, can be found by compounding them. Thus in horizontal wheeling, the resultant force, as seen from Fig. 4 (page 196) is approximately

$$F = \sqrt{F_n^2 + W^2}$$

In swooping, or undulating in a vertical plane, the resultant force at the bottom of the curve has its maximum value

$$F = F_n + W$$

and at any other part of the vertical path it has a more complex, though smaller, value which need not engage us here.

It is obvious from the foregoing discussion that the greatest stress in the machine occurs at the bottom of a swoop if the machine be made to rebound on a sharp curve. The total force $F_n + W$ sustained at this point may be found from the table if V and R be known, by adding unity to the figures given, then multiplying by the weight of the machine. For example, if the speed should be 90 miles an hour and the radius of curvature 200 feet the total force on the sustaining surfaces would be 2.84 times the total weight of the machine. In this case the stress in all parts of the framing would be 2.84 times its value in level flight, when only the weight has to be sustained. The pilot would feel nearly three times his usual weight. We may conclude from the foregoing investigation that in ordinary banking at moderate speeds on moderate curves, the additional stress due to centripetal force is usually well below that due to the weight of the machine, and that in violent flying the added stress may considerably exceed that due to the weight of the machine, and may be dangerous, unless the aeroplane be constructed with a specially high factor of safety. But there is nothing in the results here obtained that seems to make sharp curving and swooping prohibitive, for if the framing of the machine be given an extra factor of safety, at the expense may be of endurance and speed, it may be made practically unbreakable by such maneuvers and still afford to the operator and spectators alike all the pleasures of

(continued on page 196)

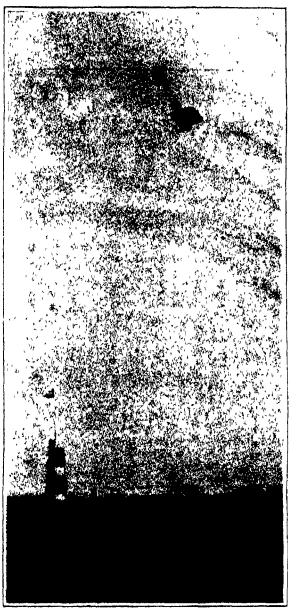


Fig. 1.—A "staircase" drop that strains a machine to the danger point when the path is straightened out in alighting.

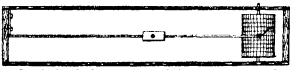


Fig. 2.—A simple device to reveal the transverse acceleration of the aeroplane in flight.

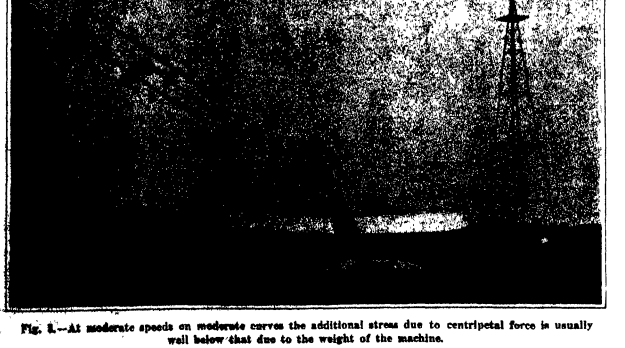


Fig. 3.—At moderate speeds on moderate curves the additional stress due to centripetal force is usually well below that due to the weight of the machine.

Magic Effects on the Stage and Off

What the Mirror Does to You

By Alfred J. Lotka

IN the issue of December 24th, 1910, of SCIENTIFIC AMERICAN Mr. Herring propounded the problem, "Why does a mirror reverse right and left, but not up and down?" In an answer by Mr Keen (January 28th, 1911) it was rightly pointed out that the cause of this inversion of printed or written characters (the example cited by Mr Herring) lies in the manner of presenting the same to the mirror It is the observer who turns the sheet about, and not the mirror

Now at first sight it may appear that this explanation completely settles the whole question, and that the image in the mirror is indeed a true and exact copy of the original In point of fact this is not in general the case, although it is in a sense true of an object having only two dimensions, such as the plane surface of a sheet of paper, and the writing upon it For this reason, in order to obtain a full understanding of what the mirror does, it is necessary to choose another object for our example, one which extends in the three dimensions of space

Let us take first of all a simple case, which for our immediate purpose may be still two-dimensional, provided it does not lie in a plane parallel to that of the mirror Suppose we present to the mirror a V-shaped object *CDE*, for example, a wire bent to the shape indicated (Figs 1 and 2) To an observer in front of the mirror, the image of *CDE* will appear located at *C' D' E'*, as shown in perspective in Fig 1 and in plan in Fig 2 Note that the point *D* which lies farthest back in the original object, in the image is represented by the point *D'* lying farthest forward Note also that *C' D' E'* may be produced from *CDE* by turning the latter *inside out*, and displacing it a certain distance backward If this is not immediately obvious, imagine *CDE* to be made of flexible material, such as string If the point *D* is held fast, and *C* and *E* are pulled forward through a certain distance, evidently a figure like *C' D' E'* is obtained We may therefore say that what the mirror does to *CDE* is to *turn it inside out*

Now, so long as the object is merely two-dimensional, as in the present example, there is little gained by this point of view For we might with equal justice say that *CDE* has simply been rotated about *AB* through 180 degrees

The matter assumes a very different aspect as soon as we turn to a three-dimensional example Suppose a glove is lying on a table in front of the mirror *AB*, as indicated in our second illustration (Figs 3 and 4) What will its image be? Suppose the glove was that which fits your right hand, the image will be such a glove as you would obtain by turning your right hand glove inside out—a left glove Figs 3 and 4 illustrate this case If you are not convinced, try it Suppose a one-legged man could be put through the operation which the mirror performs upon you Should he have had the ill luck to take off his shoe before he underwent the change so that the shoe retained its original character, he would now find that it no longer fitted his only foot! For if this was his right originally, it is now his left, and his shoe no longer fits it (Fig 5). He might of course easily avoid this awkward predicament by wearing his shoes while being "turned inside out," in which case his shoe also would be converted into a left shoe. The perfectly symmetrical man would not be affected in any way, as regards

(Continued on page 197.)



What the mirror does to a solid body is to turn its surface inside out.



Conjurer's trick box for "Vanishing Lady" performance.

A New "Vanishing Trick" Box

A FAVORITE trick both with the professional conjurer and the amateur is to cause the unaccountable appearance seemingly from nowhere of various objects or persons, and their equally mysterious disappearance. Various artifices and devices have been used, according to circumstances, to produce these enigmatic effects. Our illustration shows a new form of trick box, by the aid of which the conjurer may for example exhibit the remarkable manifestation of "the vanishing lady." The mechanism of the device is very simple. The box is provided with a drawer, which slides out backward, in the direction away from the audience, so that when withdrawn it is hidden from view, its front panel then forming the back wall of the box as seen by the audience, when the flaps in the sides of the box are opened for inspection. The conjurer starts by opening the lid at the top of the box. A system of cords (*IF*) and pulleys is so arranged that this action of lifting the cover at the same time causes the drawer, containing the vanishing lady, to retreat backward into the position shown in the body of the illustration. The cords may be made black, so that to the audience they are invisible The flaps are opened, exposing the apparently empty box to view To fully convince the audience, a rod may be passed through the box, showing that there is no deception. The flaps are then closed and the lid brought down The conjurer makes a few passes over the box, addresses his audience with the usual kind of patter, and presently opens the box once more, this time tilting it forward, so that the audience can look right into it from the open lid. And there, right enough, appears the mysterious lady in the box. For on closing the lid the drawer has moved forward into the box under the action of springs In making his passes the conjurer has loosened two catches, with the result that, on opening the lid for the second time, only the central portion *C* of the cover is raised, leaving behind (unknown to the audience) a narrow marginal frame (shown at *B* in the detail drawing) It is this frame to which are attached the cords actuating the sliding drawer. Hence on lifting only the main portion of the lid, without its marginal frame, the drawer is left within the box, and is exposed to view, with its contents, on tilting the box forward. There is, of course, now no difficulty in once more closing the chest, fastening the catches, and displaying once more an empty box upon opening the lid Variations and embellishments can of course be added to this performance to increase the spectacular effect But it may be left to the ingenuity of the reader to devise these for himself.

The apparatus here described was designed by Mr. R. B. Smith, an Australian inventor now resident in New York, and the accompanying drawing was prepared by the artist of the SCIENTIFIC AMERICAN from a small working model kindly lent by the inventor. Mr. Smith is identified with numerous inventions chiefly relating to clocks and illusion apparatus for theatrical use.

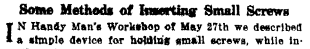
HANDY MAN'S WORKSHOP

[The Editor of Handy Man's Workshop will be glad to receive any suggestions for this department and will pay for them, promptly, if available.]

Some Methods of Inserting Small Screws

IN Handy Man's Workshop of May 27th we described a simple device for holding small screws, while inserting them into the work with a screw-driver. A number of other suggestions for doing this work have since been received and are given below

Here are three good ways for holding small screws, of either machine or wood type. A small piece of wire is bent double at one end, and slipped under the head of the screw. This serves to hold the screw steady, while the screw-driver is manipulated After the screw has a firm hold, the wire is removed A second way is to cut a small strip of tin to the shape shown in the accompanying sketch. This is a universal



Device for holding small screws.

tool, as it holds screws of different sizes A third way is to take a strip of rather stiff paper and push the screw through it at one end When the screw holds, the paper is torn away.—B F DARNELL

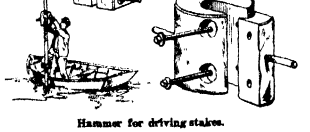
The following is a scheme that the writer has used for twenty years. Take a soft piece of wood and trim it to fit tightly into the slot in the head of the screw Press the tapered point of this wooden screw-driver into the slot, then insert the screw, screw it into the hole, and finally turn it home with a metal screw-driver With this device, one can set a screw in the back of a spring clock, or other piece of machinery, where it is impossible to reach the spot with the hand, or with the tool illustrated in the issue of May 27th.—W R. CRAWFORD

To insert small iron or steel screws, a very simple and handy way is to rub the end of a small screw-driver over one pole of a horseshoe magnet The end of the screw-driver will be readily magnetized, and will pick up and hold the small screws so that they can be inserted. Many of the small screws in clock and watch works are so tiny that a separate tool cannot be readily used without danger of dropping them into the movement.—JAMES E NOBLE

Methods of Driving and Pulling Stakes

By Albert F. Bishop

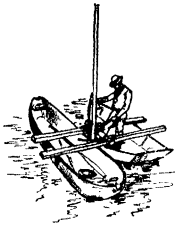
A GOOD hammer for driving mooring stakes may be made of an elm butt, nine or ten inches in diameter, and fourteen inches long. In the center a hole should be made, three inches in diameter It can be sawed on a band saw by removing the saw



Hammer for driving stakes.

guide This done, two parallel cuts should be made, three inches apart from the periphery to the hole, leaving a block which can afterward be replaced and secured to the body of the hammer by means of two five-inch bolts, as shown in the drawing When tightly bolted, the result will be equivalent to a solid ring-shaped hammer. This should weigh about 35 pounds Handles may be driven in at opposite sides of the hammer so as to permit of operating it readily In use the block is unbolted and the hammer is placed on the stake, after which the block is replaced and bolted in place again. A collar is attached to the stake upon which the blows are struck. The collar may be made of curly hickory, or wood that will not split, after the pattern illustrated, with ¾-inch bolts used for clamping it to the stake The operation of the device is shown quite clearly in the drawing, and in order to prevent the collar from slipping, it would be advisable to use spurs on the V-shaped portions of the clamps, so that they will nip into the stake

In pulling stakes the lever is commonly used, although a Spanish windlass can be operated by one person, and is very sure to perform the work satisfactorily. The windlass may be made of a round piece of hard wood about four inches in diameter, with holes bored near each end to receive the iron bars or levers with which it is turned It should be rested on a couple of half boxes hollowed out to fit the four-inch barrel. These journal boxes should be greased and should be secured to pieces of scantling laid across two boats. To grasp the stake, a chain is



Raising a stake with a windlass.



The chain grip.

used This should have a ring or hoop in one end The chain is passed around the stake and slipped through the hoop, and then is given three turns about the windlass. When the chain is under tension it will grip sufficiently to raise the stake without slipping. When lowering the chain for a fresh grip on the stake, it will slide down easily if shaken slightly by the handles

Handy Fly Killer

MY "Handy Man" made me such a fine "typhoid fly" killer, that I would like the wives of other "Handy Men" to have it When renewing a window screen, there was a small piece of the wire screen left over; my husband took a piece about 4 inches wide



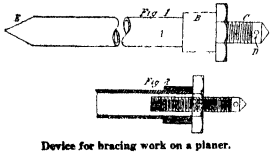
Fly killer made of wire netting.

and 12 inches long, doubled it, fastened the ends in a saw kerf, sawed in the end of a small stick about 14 inches long This gave me a "weapon," with which I can easily kill intruding flies by a sharp quick stroke; it is very effectual, indeed.—EDITH BADER

A Planer Brace

AN excellent device for bracing work on a planer or boring mill is pictured herewith

Fig. 1 shows the tool and the way it is assembled The part marked *A* is a piece of 1¼-inch pipe flattened at *B*. *B* is a nut which fits over the pipe *A*. *C* is a



Device for bracing work on a planer.

piece of 1-inch round steel threaded and drilled at *D* for the purpose of adjusting its length By having an assortment of lengths of pipe as shown at *A*, the nut *B* and rod *C* remain together and may be inserted into the pipe end at will.

Fig. 2 shows a sectional view

How to Prevent Taps from Breaking

THE sketch reproduced herewith shows a handy kink in the way of preventing taps from breaking It is very discouraging to try to tap out a small hole in a piece of work and have the tap break off in the hole. In most cases this means that you must have the broken part of the tap annealed before it can be drilled out To avoid this difficulty cut a line parallel with the shank of the tap as shown in the drawing The tap is then heated, half way between the threads and shank end, to a light blue color This



A tap that gives warning of undue strain.

will eliminate the breaking of the tap, as the shank will twist before it will break and the line will show that the shank of the tap is twisting, thus giving the user warning

This has proved to be a very valuable little kink on small taps

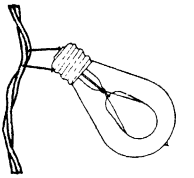
Locating a Break in an Electric Flatiron Cord

By Paul H. Woodruff

ELECTRIC cord of the kind furnished for connecting an electric flatiron with the supply, by way of a plug inserted in a lamp socket, is usually heavily insulated with a thick covering of rubber and a sleeve of coarse woven cotton For this reason it is rather difficult, when the conductor becomes broken inside its covering, to locate the exact point of the break, because since the insulation is much stiffer than the stranded copper conductor itself the ordinary bending test will not show the injury with any degree of certainty

As an example, a household electric flatiron recently "went dead," and an examination showed that the heating elements and the terminals of the iron were all right To all outward appearances and tests the cord was all right, too, but a lamp connected by a pair of short wires to its apparatus end failed to light up As it was inexpedient to obtain a new cord at once, and the implement was needed immediately, the following simple test was resorted to

The plug on the end of the cord being screwed into the supply socket, with the socket key turned to "off," two common brass pins were inserted into the double cord, one into each conductor The pins were so placed that their points pierced the cotton and rubber



Locating a break with lamp and pins.

insulation and made contact with the stranded copper conductor within The key switch was then turned on and an ordinary sixteen candle-power incandescent lamp, held in the hand, was pressed against the heads of the two pins in such a manner that one pin made contact with the metal sleeve of the lamp base, the other with the metal button in the center of the base The lamp immediately lighted up, showing that the cord was intact from the plug to the point where the pins were inserted

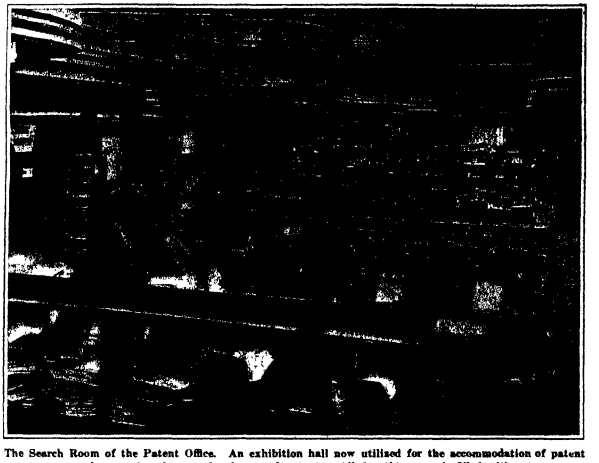
The current being turned off again, the pins were withdrawn, and replaced at a lower point in the cord—that is, nearer the apparatus end—and the lamp was pressed against them This process was repeated at intervals of a few inches until a spot was found, within a few inches of the flatiron end, where the lamp did not light up. The pins were then moved back and forth until the exact spot was found where the current ceased to flow The cord was then cut off at this point and one of its conductors found to be broken cleanly in two It was an easy matter to strip the insulation from the newly cut ends and reinsert them in the flatiron connector plug, when the iron was found to be as good as ever

This is an extremely simple "kink," but, like many other simple things might not occur to everyone who finds himself in the same predicament The most important precaution to observe is to turn the current off before inserting or removing the pins A shock in the fingers is not serious, but it is a trifle unpleasant, especially with alternating current at 110 volts

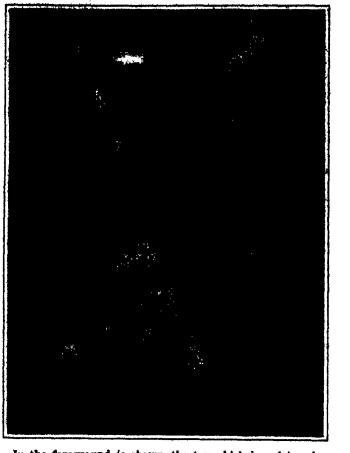
Soldering Flux.—A good soldering flux for copper is a heavy paste of resin This paste is made by dissolving as much resin in benzine as the benzine will take up The paste is easily applied with a stiff brush.—H. D CHAPMAN

The Inventor's Department

Simple Patent Law; Patent Office News; Inventions New and Interesting



The Search Room of the Patent Office. An exhibition hall now utilized for the accommodation of patent attorneys, who examine the records of granted patents. All day this room is filled with attorneys and their assistants, who sometimes appear in such great numbers that they are forced to use the halls and other rooms for their work.



In the foreground is shown the tar which has dripped from the model-vault lights, to protect the boxes from which old carpets and tarpaulins have been spread.

The Need for a New Patent Office

The Overcrowded Conditions in an Obsolete Type of Building

THERE is one thing which the inventors of this country have not yet obtained and which they have a right to demand, and that is a new building for the United States Patent Office.

When it is stated that the inventors have the right to demand it, that is exactly what is meant, in spite of the fact that the small army of examiners and clerks who work day in and day out within the walls of the old Patent Office, in cramped and out-of-date surroundings, would be affected most materially and directly by the erection of a new and commodious building. The discomforts that these latter must bear, and the very obvious disadvantages under which they labor, are not nearly so far reaching or important as the fact that poor facilities for work retard work, and the fact that employees are laboring under conditions which ought not to exist and which would scarcely be tolerated in a well-ordered and up-to-date factory, leaves the inventor, who is the sole customer of the Patent Office, in the position of not having his work done with the dispatch and expeditude which he should expect from his dealings with the Government, and which might obtain were the force of workers not herded together in an old-fashioned and overcrowded building.

This statement may come as something of a surprise to the readers of this article. Most of the inventors have seen a picture of the Patent Office. That is to say, they have seen pictures of its outside. There is no intention to belittle the classic outlines and graceful proportions of the Patent Office structure, which as an architectural achievement leaves nothing to be desired. It is a handsome and solid building of white stone, and has the appearance of an old Greek temple, or if one does not care for romantic comparisons it may be likened to the appearance of an art gallery or a museum.

But there are about one thousand people inside of this beautiful building who have something else to do besides contemplating its architectural grandeur. It is not surprising that some of them should wish for modern conveniences in place of classic excellence. A quarter of a century ago the working force of the Patent Office occupied but a small part of the building. Various Secretaries of the Interior have, however, from time to time, managed to get rid of the Land Office and the Indian Office and some other bureaus of Uncle Sam's largest department, and they have been housed elsewhere. At the present time only the personal staff of the Secretary of the Interior shares the building with the Patent Office. Secretary Ballinger, indeed, offered to move out of the quarters he occupied, if by so doing he could relieve the growing need of the Patent Office for more space. The few rooms, however, that the Secretary's force could relinquish would not permanently benefit the Patent Office. To tell the truth, it has outgrown its present quarters, and a new building has become a crying need.

One has only to enter the Patent Office and look about him to realize the weight of this statement. Like a boy who has long since outgrown his Sunday suit, but who is required by parental authority to continue to wear it, the Patent Office goes on expanding without room for expansion. The boy's arms hang far below the sleeves of his jacket, and his legs look ridiculously attenuated in the short, tight pants. It is unfair to the boy to make him the laughing stock of his companions. It is equally unfair to build costly modern buildings at public expense for other branches of the Government, and let the Patent Office, which is one of the few bureaus of the Government that is absolutely self-supporting, and which has an actual surplus of nearly seven millions of dollars, all of which has been paid in by the inventors of the country, go on occupying its old quarters, which, like the boy's suit, have bulged at the seams these many years.

Take, for example, the matter of the storage of records. Can anyone be so insensible to the value of the records of the inventions of the last century to claim that their careful preservation is not a matter of the gravest importance? Every conceivable inch of space in the Patent Office is now being used for the storage of valuable records, which if they should ever be destroyed, could never be replaced. The hallways are used for the shelving containing the copies of granted patents. These copies are being constantly called for, and must be kept right at hand, where they can be easily found at a moment's notice. Yet their orderly arrangement is impossible, when they must be put wherever there is available space. There are now over a million of patents which have been granted, and the office must keep on hand a sufficient supply of copies of these to satisfy daily and hourly demands for them.

Room must also be had for the convenient and safe filing of the original papers in each one of these patent cases. The drawings, too, must be carefully preserved, for together they constitute an actual, visible record of the achievements of the American people in the field of invention since the establishment of the patent system. Where in all of the different branches of the Government is there a more valuable collection of papers, or a more authentic and significant record of the progress man has made in the last one hundred years?

The Scientific Library of the Patent Office, with its priceless collection of publications on the subject of inventions, including copies of two million foreign patents, occupies a small section of a corridor, and the books are inconveniently disposed in a very restricted portion of the galleries which were originally intended for the display of models. The value of the library is almost beyond estimate, as many of the publications in the collection could not be replaced. In the old-fashioned building, which is not fire-proof or modern, they are exposed constantly to the danger of destruction by fire. The warning furnished by two previous fires of a disastrous nature in the Patent Office, has passed unheeded. The Assignment Division, which is one of the largest in the Office, occupies a corridor, also intended at one time for the model exhibit. In it are kept the records of the titles to inventions. The deeds showing these titles are as important, if not more so, as any collection of deeds to real property, and their destruction would be a calamity so far reaching as to touch the rights of nearly all the leading manufacturers and merchants of the United States. In this division the desks of the clerks are packed closely together, none of the clerks get the number of cubic feet of air prescribed by the rules of hygiene, and some of them work all day under artificial light. The galleries are filled with the copies of patents, which now overrun the entire building.

Many of the examining divisions occupy cramped and badly lighted rooms. Each division is forced to keep its own files of pending applications, and from five to eight persons are the rule in each room, and more are frequently found. Even the basement of the building has been partially remodeled, so that some of the store rooms could be utilized for the use of the working force.

When it is remembered that dust, rats, and mice, to say nothing of possible conflagrations, create irreparable damages in a comparatively short time, the proper housing of the Patent Office becomes a

question of national interest. Every inventor and manufacturer of the nation may be said to suffer from the danger that would arise from the destruction of some important paper, the bearing of which on a future invention might be of the utmost importance.

The same is true of the Patent Office models. Upon an improper understanding of the matter, Congress has during the last few years made many attempts to dispose of these models by sale, gift, or otherwise. When they were crowded out of the Patent Office, they were placed on exhibition in a building adjacent to the Office in expensive glass cases, so that they might not only be accessible as a part of the official records in frequent use by the Office and for use as evidence in suits in the United States courts, but that they might also furnish a very interesting and instructive exhibit to the general public. It was customary for excursions from colleges and schools to visit Washington mainly for the purpose of studying this exhibition of historical objects, which showed the development of the mechanical arts

Subsequently Congress omitted to appropriate money for the rental of these exhibition halls, and the models were placed in storage. The cases were sold and the models nailed up in wooden boxes, labeled, and given over to perfect oblivion, so far as the public is concerned.

Eventually Congress was convinced that it would be a mistake to dispose of these models, owing to the fact that they are still used in the courts as evidence in important cases, where vast sums of money have been saved in litigation on account of the irrefutable testimony given by these inanimate but eloquent witnesses

The high state of perfection reached by mechanical drawing now renders the construction of a model to accompany applications for patent unnecessary Previously to the early '80's the drawings submitted did not always disclose clearly the real invention, owing to poor mechanical drawing, and models were absolutely essential. It is evident, therefore, that the present collection of models is the only real proof, actual and existing, of numerous inventions, and each and every one is liable to be called for and relied upon as evidence in the courts to-day

The framers of the Constitution of the United States recognized particularly the necessity for encouraging the development of two faculties of the human mind in order that the young republic might speedily take her place in the front rank of the nations of the world. These faculties, thus recognized and encouraged, were those of literature and invention. Accordingly there was embodied in the Constitution that provision that Congress should have the power to promote the progress of science and the useful arts, by securing for limited times, to authors and inventors, the exclusive right to their respective writings and discoveries. Under this wise provison the present patent and copyright laws have been enacted by Congress.

The Library of Congress, one of the world's most beautiful structures, is proof enough that the artists of the nation, the authors, the musicians, have not knocked in vain at the door of Congress that their works might be preserved to posterity forever. The new National Museum too provides ample room for the display and preservation of records of the past, pertaining to archeology, zoology, anthropology, geology, and history. The implements of war and peace presumably used by prehistoric races are spread out before the public and are available for research by the student. The whole history of man may be studied and contemplated by whosoever will.

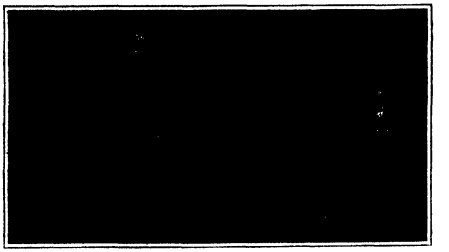
On the other hand, the Patent Office models, the actual embodiments of the first inventions of our many arts and sciences, are allowed to lie—more than one hundred and fifty thousand in number—stored in wooden boxes in the cellar of the office building of the House of Representatives. Not that they are wanted



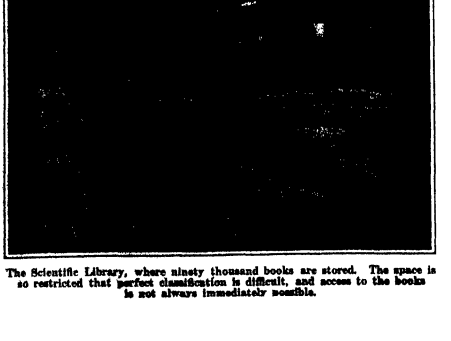
Portion of the corridor, 20 by 40 feet, in which twenty-two persons operate typewriters; the ceiling is 8 feet 3 inches from the floor.



Storage place for copies of patents in space originally intended as an exhibition hall for Patent Office models. All the available room in the halls of the building is thus occupied by copies of patents.



In this room in the Patent Office, divided by a temporary partition, twenty-four persons work all day under artificial light. The windows look into the north portico and no sunlight ever comes into the room.



The Scientific Library, where ninety thousand books are stored. The space is so restricted that perfect classification is difficult, and access to the books is not always immediately possible.

there! But Congress would not appropriate money for their proper keeping, and there is no longer any room for them in the old Patent Office building They had to be sheltered somewhere, and a few vaults happened to be empty in the new House office building, so consent was given to store them there

The mere fact that models are not longer required by law to be filed by the inventor with his application for patent, does not render those that have been so offered and accepted in the past any less valuable as records and evidence In fact, their value as exhibiting what has been done in the past in nearly all known arts increases rather than diminishes as time goes on

When the Patent Laws were revised in 1870, the following provision was inserted in the Revised Statutes

"484. The Commissioner of Patents shall cause to be classified and arranged in suitable cases, in the rooms and galleries provided for that purpose, the models, specimens of composition, fabrics, manufactures, works of art, and designs, which have been or shall be deposited in the Patent Office, and the rooms and galleries shall be kept open during suitable hours for public inspection."

In spite of this mandate of the law, inventors and manufacturers, visitors and tourists now inquire in vain at the Patent Office for the rooms where the models are displayed They are surprised to hear that they are stored in almost inaccessible cellars

It is difficult to reconcile this history of the Patent Office models with the beneficent government which provides palatial buildings for nearly every branch of the service, and erects stately museums and libraries. This anomaly could easily be overcome by the erection of a new and suitable building for the Patent Office, and it should speedily become the business of every citizen—for every citizen benefits by the patent system of the United States—to advocate the construction of such a building

As pointed out in the early part of this article, the Patent Office has an absolutely net surplus in the United States Treasury of nearly seven millions of dollars Every dollar of this has been paid in by the inventors of the country The sum is more than sufficient to build an adequate and modern building for the Patent Office. Congress has only to give the necessary authority, it does not have to appropriate a single dollar out of the revenues of the Government The money is there, the Patent Office has earned it, the inventors have paid it in There ought to be a building wherein the records of inventions could be safely and conveniently kept, beyond all danger of destruction There ought to be well-lighted and properly ventilated accommodations for the examiners and clerks who perform the difficult and important work of determining whether an invention is new or old Moreover, inventors have the right to demand that the facilities be furnished whereby their applications for patent can receive the highest possible degree of care and accuracy in examination

It is not likely that this neglect on the part of Congress to provide for the Patent Office has been deliberate, but it arises from the fact that most of the members of Congress are not in possession of the facts regarding the needs of the Office What is required now is a campaign of publicity, a campaign whereby not only Congress, but the people everywhere, may realize that the inventors of the nation are paying for something to which they are justly entitled in the Constitution, but which they do not always get

Without great commercial resources and activity a nation cannot become great The inventors and the manufacturers, the buyers and the sellers furnish the sinews of the country, and upon invention and invention alone has commerce been founded. Invention, instead of lessening the number of distinctive kinds of employment, has been shown by actual experience to have increased them

The late Senator Daniel of Virginia, who was an enthusiastic worker for the inventors, is the author of a bill which expired with the last Congress, but which provided for and specified the particular location upon which the Greater Patent Office should stand. This site is immediately north of the Library of Congress, facing the east front of the Capitol

It is inevitable that this site must ultimately be occupied by a Government building, and since the Patent Office is the twin sister of the Library of Congress, considering its protection of the products of the human brain, there is no doubt that it should be so located. The present Commissioner of Patents has repeatedly urged in his reports, and orally, to Congress the necessity for improved and modern quarters for carrying on the work of this important bureau Every month that passes deepens the gravity of the present situation, and since it will take years to erect such a building as will be required, the action should be taken by Congress at the earliest possible moment

Notes for Inventors

Liming Apparatus Needed.—In many localities the soil is limed at intervals and it is very common to see piles of lime spaced apart throughout the fields The former practice in liming the soil was to apply large amounts (1 to 3 tons per acre) at long intervals. Investigation has shown, however, that, as a rule, it is better practice to apply smaller amounts (500 to 1,000 pounds per acre) at shorter intervals One difficulty in the way of a general adoption of the latter practice has been the lack of an implement that will evenly distribute such small applications of lime It ought not to be difficult to devise such a distributing machine, and there is no doubt that an efficient implement for this purpose would aid greatly in promoting a desirable agricultural practice.

A New Form of Package.—The wrapping of merchandise, particularly proprietary articles, whether they be medicines or breakfast foods, has received much thought and great advances have been made. There appears, however, to be a field for improvement in a wrapper which will serve its purpose as a distinctive, attractive label for the package until it has been sold at retail to the consumer and can then be utilized to wrap the package for the customer in the usual way This might be effected in various ways, such, for instance, as by breaking a seal on the label wrapper and reversing the latter to bring its plain side into position to form the outer cover of the package Such a wrapper should be popular with the retailer, the field of usefulness is practically unlimited and a satisfactory solution of the problem will doubtless require the careful consideration of an ingenious inventor.

Fishing by Machine.—Just think of a man out fishing and wanting mechanical help in catching the fish! This is provided by Wladyslaw Filipowski of Hawthorne, Ill., in a patent, No 999,214, for a fishing device which may be screwed into a post, pile or other support and has a spring arm over which the line is guided and a trigger to which the line is connected so that tension on the line, as when a fish bites, will pull the trigger and release the spring arm so it can pull upon the line

New Baseballs Two baseball patents, Nos. 999,526 and 999,527, have been secured by Benjamin F. Shibe of Bala, Pa One of the patents shows a ball with a rigid, inflexible central core and layers of thread wound upon it and the other a layer of highly resilient material between the inflexible core and the layers of thread In the description accompanying patent No 999,526 the patentee states that heretofore baseballs have been constructed with the dilapentous windings on a central core or foundation of a resilient, yielding substance such as rubber, upon the theory that the "rebound ancy" of the structure was derived from the action of the resilient quality of the central core, but he has found that the use of a resilient core is unnecessary to produce resiliency in the ball, but that by the use of a rigid, unyielding and inflexible center core the reaction of the resilient qualities of the windings from a blow is more prompt and of greater effect and that the ball responds or rebounds with greater resiliency from the bat than if the core were more resilient and less resistant. When it is considered that probably more than twenty-five thousand baseballs are made every working day in the year, the importance of improvements in this line becomes evident.

A Bow Separator for Motor Cars.—The Packard Motor Car Company is the assignee of a patent, No 994,852, for a bow separator for vehicle tops, invented by Allen Loomis of Detroit. The separator is especially for use on automobiles, and the machine has a rest on which is supported the lower long bow of the top when the top is lowered The separator is to hold the bows apart so they will not rub against one another Thus the separator is supported on the lower long bow and it has recesses which receive the intermediate bows, and also supports the upper long bow. Thus all the bows can be secured together and be supported on the vehicle and the weight of the top bow will not be exerted on the intermediate bows and the bows will not rub against one another.

Melting of Snow.—Samuel Friedman of New York city has patented No. 999,445, a snow melting machine, and a method of converting snow into slush, the latter consisting in imparting heat to the snow and also adding salt to prevent the formation of caked masses of snow The machine has a tank and a chute through which the snow is conveyed to the tank, and a spring-supported plow, which can yield to pass obstructions

Legal Notes

Classification of German Patents.—The United States Patent Office has for sale a translation of the Manual of Classification of the German Patent Office This translation and the numerical list of German patents, classified according to classes, sub-classes and groups, accessible in the Scientific Library of the United States Patent Office, will greatly facilitate the searches in the German patents.

Applying to a Court for a Patent.—In sustaining a demurrer and dismissing the bill in the case of Westinghouse Electric & Manufacturing Company v Ohio Brass Company, 169, O G page 284, the United States Circuit Court for the District of New Jersey held that the remedy by bill in equity to obtain a patent which has been refused by the Patent Office, is a part of the application for patent and the failure of the complainants to institute proceedings within one year after the last official action on their application, to wit, the adverse decision of the Court of Appeals of the District of Columbia, is a bar to such proceedings by bill in equity.

Ex Parte Harris.—In affirming the decision of the Commissioner of Patents, in the case of ex parte Harris, the Court of Appeals of the District of Columbia has decided that claims, for a method of preparing beverages, which include the three steps of preparing, storing and dispensing the beverages, cover mere aggregations, since each of these steps is complete in itself and independent of the others The method involved was for preparing beverages such as tea or coffee, in which a current of boiling liquid was admitted within a charge of material, the resulting infusion was heated to a steaming condition, and the infusion so produced was stored under the pressure of the steam evolved therefrom and free from contact with the charge.

RECENTLY PATENTED INVENTIONS.

These columns are open to all patentees. The notices are inserted by special arrangement with the inventors. Terms on application to the Advertising Department of the SCIENTIFIC AMERICAN

Pertaining to Apparel.

BARRETTE.—A. SCHAER, New York, N. Y. The objects of this invention are to provide a barrette which, when once placed in the hair, will be securely locked in position by gripping the strands of hair, and thus keeping the stray locks in place, and avoiding danger of displacement or loss; to provide a barrette which will be simple of construction, ornamental and readily attached and detached.

Of Interest to Farmers.

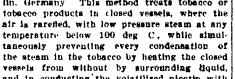
INCUBATOR.—G. H. LEE, Omaha, Neb. Among the principal objects the invention has in view are: To provide means for ventilating an incubator wherein the ventilation is diffused, preventing the formation of drafts and avoiding the necessity of forcing air through the machine, and to provide a simple, efficient and durable construction whereby the ventilation may be varied.

THRESHING MACHINE.—C. M. FRICK, Township 23, Pawnee County, Kan. This invention provides a feeding conveyer which may be thrown in one position so as to feed the material to the threshing part of the machine, or may be shifted to another position, in which it feeds the material over the end of the machine onto the ground. Another feature is a screen for sifting grain from chaff, which will be automatically maintained in a substantially horizontal position irrespective of whether the machine is going up or down hill

Of General Interest.

METHOD OF REMOVING NICOTIN FROM TOBACCO.—J. SARTIG, Nikolassee, near Berlin, Germany This method treats tobacco or tobacco products in closed vessels, where the air is rarefied, with low pressure steam at any temperature below 100 deg. C., while simultaneously preventing every condensation of the steam in the tobacco by heating the closed vessels from without by surrounding liquid, and in condensing the volatilized nicotin with the steam carrying it away to devices of any known construction for recovering the nicotin

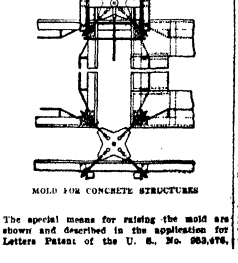
FOUNTAIN PEN.—W. A. HOUSTON, Tracy Pen Co., Tracy, Minn This device insures a uniform flow of ink to the pen nibs and paper, and its simple construction affords means for preventing the dropping of ink from the feeder or pen point to the paper in case the ink is fed too freely at times,



FOUNTAIN PEN

whereby the surplus ink supplied is effectively taken up and retained until required, the writing rendered uniform and regular, and blotting, caused by the dropping of ink from the pen point, is avoided The overflow reservoir is so constructed that a relatively large amount of surplus ink may be confined within a small space at the end of the feeding device The device illustrated herewith is a sectional view taken axially through the nozzle portion of the pen provided with the feeding device, and showing part of the end of the ink reservoir

MOLD FOR CONCRETE STRUCTURES.—J. S. LINTON, 1530 South Central Park Avenue, Chicago, Ill The illustration in this case shows a mold or form for making concrete structures, such as walls, columns, beams, etc., and arranged to securely hold the mold parts in position, to allow of raising the mold as the building of the structure progresses, and to temporarily support the concrete material to be used in the formation of the structure



MOLD FOR CONCRETE STRUCTURES

The special means for raising the mold are shown and described in the application for Letters Patent of the U. S., No. 983,476, granted to Mr. Linton. The mold is provided with sets of uprights having brackets for supporting horizontal beams extending from one set of uprights to the other and in which the mold sides are secured so that the concrete material can be readily filled into the space between the opposite mold sides.

Hardware and Tools.

RAZOR STROPPING DEVICE.—MILLARD F. COONS, 414 Broadway, New York, N. Y The invention has for its purpose the provision of a device with two arms articulated together, one of the arms being pivoted to the frame in which the stropping member is secured, a razor blade being mounted on the other arm The perspective view of this durable strop shown in the engraving represents the device in use. While it is not necessary to be used a honing strop can be readily applied to



RAZOR STROPPING DEVICE

the device The device is simple in construction and easily operated when placed in the palm of the hand The blades can be sharpened with great rapidity, and an easy free and clean swing of the blades may be obtained against the strop member The complete outfit weighs three ounces This improvement is Patent No. 1,000,237, issued August 8, 1911, and is to be commercially known as the "Millard Simplicity Stropper."

Heating and Lighting.

FURNACE.—W. SCHEWELER, Gulfport, Miss. In this patent the invention has reference to furnaces for melting lead, and for other purposes, and has reference more particularly to a furnace in which is provided a movable support for a crucible or the like, together with means for moving the support into and out of the furnace

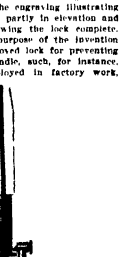
Household Utilities.

KITCHENETTE STOVE.—E. S. ALLEN, New York, N. Y The inventor mounts a kitchenette stove upon journals or bearings and provides it with gas from a gas pipe section, this gas pipe section being provided with a valve fitting into a stationary fixture to which gas is supplied, the arrangement being such that when the stove is tilted into either of its two positions the gas is turned on or off by the action of the valve

Machines and Mechanical Devices.

ADDING MACHINE.—C. B. CORELL, New York, N. Y In this patent use is made of connected number wheels, a spindle and a stop bar ranging across the wheels, the said wheels and spindle being adapted to turn loosely one on the other, each wheel having its periphery provided with consecutive numerals alternating with recesses for engagement by a pencil in the hand of the operator, to govern the relative movement of the adjacent wheel and spindle, the stop bar turning with the spindle and forming a stop for the pencil or tool.

SPINDLE LOCK.—MATTHEW OMALIA, care Reynolds Brothers, 128 Coal Exchange Building, Scranton, Pa The engraving illustrating this lock gives a view partly in elevation and partly in section, showing the lock complete. The more particular purpose of the invention is to provide an improved lock for preventing the removal of a spindle, such, for instance, as is commonly employed in factory work,



SPINDLE LOCK

from its mounting, yet allowing the spindle all the freedom of motion which it now has, and also permitting the removal of the spindle when the operator wishes to release the lock. Means provide for mounting the latch in position and there is a special provision for supporting the latch by aid of a rivet; and since the latter has been used means provide for the rivet being headed up the second time.

LEGAL NOTICES

PATENTS

If you have an invention which you wish to patent you can write fully and freely to Munn & Co. for advice in regard to the best way of obtaining protection. Please send sketches or a model of your invention and a description of the device, explaining its operation.

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PATENTS FOR SALE.

U. S. PATENT FOR SALE, March 18, 1913.—Patent No. 956,584—For device "Non-Refillable but effectively made so by specially devised stopper of simple construction and cheap manufacture, practically adaptable in principle to any form or size of bottle Also Canadian Patent, among others granted for. Our full line of the above, either separately or together. Terms Cash. All communications covering offers for same and for further particulars, please address, Chas E. W. Archer, 4 N Price Street, Point of Rocks, Md. R. W. L. or Arnold A. Waterman, Merchant, 15 Frederick St., Trinidad, B. W. I.

FOR SALE—All or half interest in Pat. Screen door Fly trap Traps all the flies in the room in fifteen minutes. Sell all that accumulate on outside of screen. Address J W Robinson, Rogers, Ark

PATENT FOR AUTOMOBILE NOVELTY, stock and supplies. Business established more than three years. Worth investigating Splendid opportunity for live party H W Funk, 304 Topeka Ave Topeka, Kan

ARTIFICIAL RAIN.—New system of irrigation combined with electrified wires. Best and cheapest fertilizer. Patented. Capital wanted to exploit same or will work on royalty basis. Patent for sale for respective points from fruit trees to Mississippi. 27 Park Row, N. Y. City.

U. S. AND CANADIAN PATENTS on cattle guards and automatic seating Price $500 Will send working model to prospective investor for examination on request. For particulars address, H. H Herring, Atascosa, Texas

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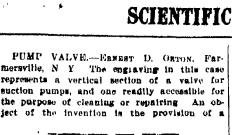
FREE—"INVESTING FOR PROFIT" Magazine. Send us your name and it will mail you this book absolutely Free. Before you invest a dollar anywhere—get this magazine—it will be worth money to any one who intends to invest $5 or more per month. Tells you how you may make $5 grow into $500—how to judge different classes of investments; the Real Earning Power of Your Money. Do not invest another dollar till you write to-day. E. H. L. Barker, Publisher, 603, 30 W. Jackson Blvd., Chicago, Ill.

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CLEANING Kerosene is the surest way to clean. Rub Vaseline on Leather Coated. One cent will clean this. Write us for it. (I will buy all you need.) Groves Automatic Lubricating Foot Power Hand Drill. It runs on foot and leaves both hands free to operate tools. Write for it to-day. W. E. Hamilton, 484 Lakewood Ave., Lexington, Ky.

PUMP VALVE.—ERNEST D. ORTON, Farmersville, N Y The engraving in this case represents a vertical section of a valve for suction pumps, and one readily accessible for the purpose of cleaning or repairing An object of the invention is the provision of a



PUMP VALVE

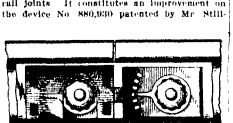
valve with means for adjusting the tension of said valve, for elevating water at different heights Further, to provide a valve with means for lifting the same by direct downward contact, to reduce the water limitioned above the valve The valve may be adjusted to any pump already in use by cutting out the old valve and lowering into its place this improved valve, which is readily secured in position by means of lugs.

Prime Movers and Their Accessories.

ROTARY ENGINE—T IDBAL, Camden, N J An object here is to provide a novel form of engine in which a single rotary piston is acted on at several points in its rotation by the admission of fresh air Means are provided for operating the abutment valves, so as to insure the greatest economy in the workings of the engine Means provide for controlling the exhaust ports The inventor accomplishes this by a series of valves whose position may be simultaneously adjusted by the manipulation of a single lever A further object is to provide means for regulating the steam inlet

Railways and Their Accessories.

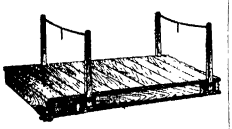
NUT LOCK—CLAUDE B STILWELL, P O Box 522, Savannah, Ga This invention relates to nut locks, and is particularly applicable to the construction of such devices when used in securing the nuts of the bolts which attach the fish plates to the rails at the rail joints It constitutes an improvement on the device No 880,960 patented by Mr Still-



NUT LOCK

well In the present case, the invention contemplates the use of improved means for preventing the nut from rotating on the bolt, and the principal object of the invention is to provide means for covering the mechanism of the device so as to prevent it from being injured or displaced The illustration in the larger figure represents a side elevation of a railroad rail joint showing a modified form of the invention, and the smaller is a prospective view of a modified form of the lock plate

CAR STAKE POCKET.—CHARLES PYLE, Ironwood, Mich This invention refers to load retaining means for vehicles, and especially to means whereby side stakes are positioned upon platform and logging cars, and which may be held in vertical position against



CAR STAKE POCKET

the pressure of a load, or may be easily released from a position of safety A further object is to provide a stake pocket capable of disengaging the stake quickly without time being lost in cutting off the stake close to the pocket, and the consequent removal of the short piece therefrom; and has for a further object the provision of means whereby any form of stake may be used, or in which a particular shaped set of stakes may be carried The illustration shows the device applied to a car platform

NOTE.—Copies of any of these patents will be furnished by the SCIENTIFIC AMERICAN for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

Notes and Queries.

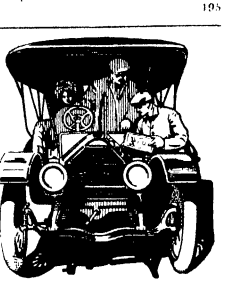
Kindly keep your queries on separate sheets of paper when corresponding about such matters as patents, subscriptions, books etc. This will greatly facilitate answering your questions, as in many cases they have to be referred to experts. Be full name and address should be given on every sheet. No attention will be paid to unsigned queries. Full hints to correspondents are printed from time to time and will be mailed on request.

(12522) H L W asks What causes the changes of the barometer at a given point? A The changes of the barometer at any given place are caused by the change in the pressure of the air about that place The atmosphere has waves in it of greater and less pressure, and these waves move around the earth, following each other much as waves chase each other over the ocean A high follows a low, and a low follows a high A low barometer has been traced for about five weeks from the coast of Asia across the Pacific, America, the Atlantic, Europe, and into Siberia While there are erratic changes there is also a general flow of areas of greater and of less pressure to which the barometer responds

(12523) A E H asks Some months ago you published in your Answers to Correspondents an explanation to show that if an object sinks at the surface of water, it will sink to the bottom, no matter how deep the water may be the great pressure at increasing depth having no effect to keep the object suspended I inclose 10 cents in currency and postage Will you kindly send me a copy of your paper containing that statement? Or, if you prefer, simply give an answer in an early issue, where I shall see it as I buy the SCIENTIFIC AMERICAN regularly A The question of sinking or floating is determined by a law known as the Principle of Archimedes It is that an immersed body is buoyed up by a force equal to the weight of the fluid displaced If a body under water weighs less than the water it displaces it will rise If it weighs the same as the water it displaces it will remain where it is If it weighs more than the water it displaces it will sink And if it begins to sink and no change is made in it, it will continue to sink, because it is more compressible than water If it is heavier than water at one level still more will it be heavier than the water at a lower level, since in going to the lower level it has been compressed by the water more than the water itself has been Our attention has lately been called to the case of the submarine, which can be held at a selected depth But the volume and the weight of the submarine are changed by admitting or removing water to adapt it to its desired depth, and it is made to have just the weight proper for the level it is to maintain If it should begin to sink and no change were made in it, it would continue to sink to the bottom It is no exception to the general case The expression you use "the greater pressure at increased depth having no effect to keep the body suspended," is not quite correct It has an effect but not enough effect To put it in another way, the sinking body becomes denser more rapidly than the water does at increased depths, and so must continue to sink This is one of the questions of frequent recurrence We recently gave the coefficient of compressibility of steel, one of the hardest metals and least compressible It will be found in Vol 124, No 125, to which we refer for further statement

(12524) J S J says I am installing an electric bell circuit with three bells and four cells attached Will you please tell me in your Notes and Queries lines which is the most desirable to connect cells in series, in multiple or in series multiple A Probably four cells in series will be sufficient to ring three bells, though only a trial can determine that matter If it is not sufficient add more cells The usual mode of arranging a bell battery is in series When a sufficient number of cells have been put in series to give the voltage for the bells, you can get the necessary amperes by a second series of the same number of cells in multiple A multiple arrangement of single cells is not desirable

(12525) E P W asks: If a locomotive drawing ten passenger cars running at a rate of speed of 40 miles an hour, should have every wheel of the locomotive and of each car securely locked at the same moment, would the momentum of the train stop at the same time? And what would be the probable effect on the train by the locking of each of the wheels at the same moment? A If the wheels were locked by the brakes so that they ceased to revolve, the train would slide on the wheel rims until its momentum was exhausted If you mean, however that the wheels are to be locked to the track suddenly we can only say that neither wheels nor car bodies, nor any other moving particle, can ever be *instantly* stopped except by *infinite* force, that is, by a force greater than any known quantity No moving train could have its momentum instantly taken away, the attempt to do so has destroyed much rolling stock in railroad wrecks.



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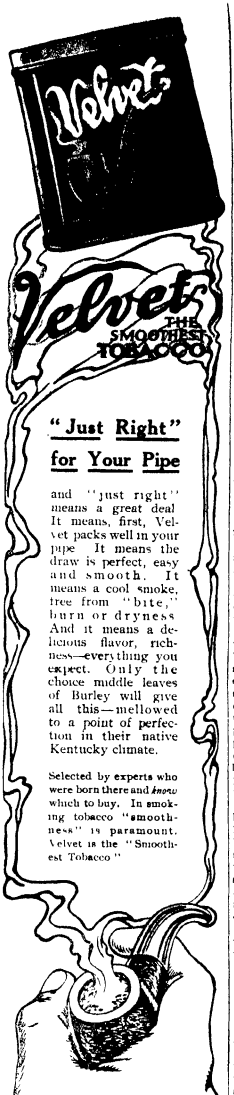
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"Ask the man who smokes it"

Convert Abandoned Mills into Electric Power Plants

(Continued from page 195.)

wires at a high voltage over an extended area there is little difference from a point of view of risk to life between one high voltage and another. Only the best of construction should be used and proper provision for safety must be observed. This is not always the case with distribution systems having a voltage of about 2,000, and for that reason a voltage of 10,000 volts has an added advantage.

With a co-operative system the farmer can erect much of the line work himself, thus accomplishing a saving. Poles may be prepared in the winter time when work is not heavy. In some of the newer transmission installations, concrete poles are used with success and improvement in appearance. They are about 35 feet high, tapering from 15 inches in diameter at the base to 6 inches at the top, reinforced throughout with steel rods Such poles can be made at home at any convenient time of year

With a high voltage system and proper line construction the poles ought to be spaced not less than 200 feet apart and should take the most direct route from the source of electric supply to the point at which current is to be used The immediate land over which the line passes should be assigned as a permanent right of way, proper provision for legally doing this and protection from malicious or meddlesome persons being made

The cost outlay in constructing such a distribution system would be found remarkably small if the farmer should make and haul all poles and cross arms and supply the rough labor for setting poles and stringing wires The actual expenditures would, therefore, be only in purchasing wire, insulators, guys, etc., that could not be had on the ground The number and size of transformers and meters would vary according to the individual demand and local conditions These, however, each one should buy himself in the same manner that he would electric motors and lamps With such a system, all purchasing should be taken care of co operatively, thus insuring to the individuals the benefit of quantity prices In conjunction with the power plant a creamery, laundry and grist mill could be equipped and operated at very little extra expense, as the buildings and power available would prove ample for this

The total cost of the undertaking, as here outlined, including power plant and line construction, would be in the neighborhood of $30,000, to be borne by twelve subscribers, thus each must contribute the equivalent of $2,500 cash Certainly a successful farmer having upward of 200 acres should be able to muster this amount, if the investment will result in economy and safety

The cost of operating a water power plant is naturally small, and it consists merely of the interest and depreciation charges, and the salary of one or possibly two men in attendance If the plant is to give day and night service, then two men will be required, otherwise one is all that is necessary The farmers' need for lighting during the early hours of the morning and the convenience of having current for this purpose at any time of night or day makes it a better equipment to have two men available for duty The total salaries on this basis would approximate $2,000 per annum and with 5 per cent interest and a like amount to cover depreciation and maintenance of the entire equipment, we have a total yearly cost of $5,000

In regard to the amount of electricity that each farmer would be likely to use with a total equipment averaging in capacity the equivalent of 50 electrical horse power, we are safe in assuming a load factor of five to ten per cent for eight hours per day

Taking the lower figure, this represents 20 horse power hours per day for each of the twelve farmers, for which a rate of 10 cents per electrical horsepower hour would be a proper charge for the subscribers to pay for their service. This would, therefore, provide a minimum yearly income of $6,000, assuming that this average amount of electricity is consumed for 200 days each year. Hence, on the basis of this somewhat over-conservative estimate, there would be sufficient yearly return to pay the cost of full operation and insure a 20 per cent margin for profit. The plant discussed is of sufficient capacity to take care of the maximum demands of all the subscribers at any one time, and as two power units would be installed of equal size, either one would have capacity for the average demands

This outline of a real practical opportunity for farm betterment is only typical of several that the writers themselves have observed, and, doubtless, there are hundreds of small water falls of this character available if we but look for them

To be sure it is hardly to be expected that the farmer as such is going to unravel the mysteries or details of a problem of this kind alone, but we shall expect his interest and foresight in recognizing the merit of such a scheme, and, once finding out its practicability mastering the situation by so organizing that it may be successfully carried out.

The manufacturer finds capital and skilled assistants to convert his new ideas into practical commercial form, and the farmer to be successful must follow the same course.

Stress in Aeroplanes in Curvilinear and Fancy Flight

(Continued from page 189.)

frolic and fantastic flying

In order to obtain actual data for the fluctuations of stress in an aeroplane in varied flight, I would suggest that a record be taken of the stress or strain of some tension or compression member of the machine in action, or simpler still, perhaps, that a record of the aeroplane's acceleration be taken, and more particularly its transverse acceleration A very simple device to reveal the transverse acceleration of the aeroplane in flight would be a massive index elastically supported A lath or flat bar stretching lengthwise of the machine, one end fixed, the other free to vibrate, and carrying a pencil along a vertical chronograph drum would serve such purpose. The whole could be incased from the wind as shown in the sketch (Fig 2.)

An adjustable sliding weight could be set to increase or diminish the amplitude of the tracing, and an aerial or liquid damper could be added to smooth the tracing The zero line would be midway between the tracings made on the drum by the stationary instrument when resting alternately in its normal position and upside down, the distance from this zero line to the actual tracing of the stationary instrument would be proportional to the aeroplane stresses in level rectilinear flight, while in level flight on a curve,

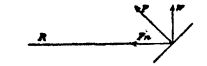


Fig. 4.—Resultant force due to horizontal wheeling.

either horizontal or vertical, the deviation of the mean tracing from the zero line would indicate the actual stress in the machine during such accelerated flight. Of course the drum could be omitted and a simple scale put in its place, so that the pilot could observe the mean excursion of the pencil or pointer from instant to instant. Also, the damping of such excursion could be adjusted to any amount in the proposed instrument, if the vibrating lath fitted its incasing box closely, with an adjustable passage for the air as it moved to and fro, or if light damping wings were added to the lath, or flat pencil bar.

Another method would be to obtain by instantaneous photography the position of the centroid of the aeroplane at a number of successive instants, from which could be determined its speed and path, or V and R of the first equation, by which data therefore the stress could be read from the first table.

Perhaps the simplest plan would be to add an acceleration penholder, with its spring and damper, to any recording drum the aeroplane may carry for recording the air pressure, temperature, speed, etc. Indeed, all such records could be taken on a single drum.

PENNSYLVANIA R. R.

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A score of devices, more or less simple, but suitable for revealing the varying stress in an aeroplane, will occur to any engineer who may give the subject his attention, and it is desirable that some one obtain roughly accurate data for the stresses developed in actual flight. This is desirable in the interest both of aeroplane design and of prudent manipulation.

It is commonly supposed by aviators that the increment of speed due to diving is very prodigious. An easy formula will determine the major limit of such speed increment. If the initial and natural speed of the aeroplane be v, and the change of level in diving be h, while the speed at the end of the dive is V, the minimum change of level necessary to acquire any increment of speed $V\text{-}v$, may be found from the equation

$$h = (V\text{-}v)/2g$$

And if, as before, g be taken as 22 miles per hour, the equation reduces to the convenient formula

$$h = (V\text{-}v)/30$$

in which V and v are taken in miles per hour. Assuming various values for V and v, the following table has been found for the corresponding values of h in feet.

Minimum Change of Level Necessary to Produce Various Speed Increments.

The Speed, v, of the Aeroplane.	Increments of Speed, $V\text{-}v$		
	Miles Hour 10.	Miles Hour 20.	Miles Hour 30.
M. H.	Ft.	Ft.	Ft.
30	23.3	53 3	90 0
40	30 0	66 7	110 0
50	36 7	80 0	130 0
60	43 3	93 3	150 0
70	50 0	106 7	170 0

For example, if the natural speed of the aeroplane in level flight be 50 miles an hour, and the aviator wishes to increase the speed by 20 miles per hour, he must dive at least 80 feet, assuming that the aeroplane falls freely, like a body *in vacuo*, or that its propeller overcomes the air resistance completely; otherwise the fall must be rather more than 80 feet.

A very instructive and spectacular contest could be arranged to determine which aviator could dive most swiftly and rebound most suddenly, the prize going to the one who should stress his machine most, as indicated by the accelerograph above proposed; but to avoid danger the contest would have to be supervised by competent experimentalists, and would best be conducted over water. It is safe to say that more than one well known aeroplane would be denied entry in such a contest, for lack of a sufficient factor of safety.

What the Mirror Does to You

(Continued from page 190.)

his clothing, only he would have to put his right glove on what used to be his left hand!

While there is a certain comic element in the point of view thus presented, it has as a matter of fact a number of important serious applications. The first point to note is that no ordinary operation, such as mere rotation or inversion, can possibly effect the change which the mirror produces. No turning or twisting of your right hand glove can ever make it into a left hand glove—except that one operation of "turning it inside out." With most ordinary objects this operation is of course quite impossible. Two ordinary objects therefore which are related to one another as the right hand is to the left, or in other words, as one object is to its mirror image, cannot by any sort of transposition be made to coincide, like two congruent figures of geometry.

This fact has found an interesting and important application in organic chemistry. It is found that certain chemical compounds occur in pairs, the two members of each pair being practically identical in all their properties, but while one rotates the plane of polarization of polarized light to the right, the other rotates the same by an equal amount to the left. Now the curious thing is observed, that in every case in which the formula of such a compound is known, it is found to contain a so-called asymmetric carbon atom, that is to say, one which is linked to four different groups or radicles. An example of this kind is lactic acid, whose formula is



It will be observed that the central carbon atom has four unlike groups attached to it. If a solid model of such a formula is made, with the links extending evenly out from the central carbon atom, it is found that there are two possible arrangements of the groups—and the two are related to each other as an object is to its mirror image, or as the left hand is to the right.

This is shown in our last illustration (Figs. 6 and 7), in which the central carbon atom of the lactic acid molecule is represented in the customary manner by a regular tetrahedron, or four-angled solid. Each corner of this tetrahedron represents one of the bonds or affinities of the central carbon atom. The four groups attached can be arranged in two and only two insuperposable arrangements, as shown, of which the one is the mirror image of the other.

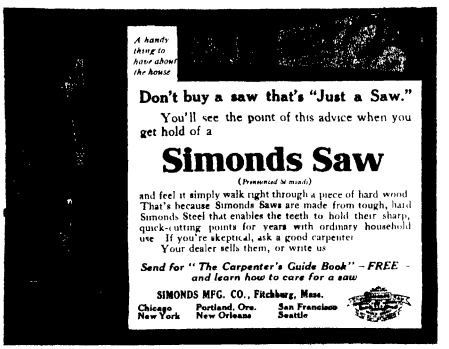
This is true only as long as the groups attached to the central carbon atoms are all dissimilar, as is the case in lactic acid. As soon as two or more of them are alike, only one arrangement is possible. The fact that such an "asymmetric" carbon atom occurs in all optically active carbon compounds whose formula is known (and they are exceedingly numerous) appears too significant to be ascribable to accident, and it is customary to regard the two twin forms—optical isomers as they are called—as represented by the two possible space formulæ, although there is at present no means of identifying each member of the pair of compounds with a particular one of these two formulæ.

The reader will recall that in analytical geometry also it is necessary to distinguish between two kinds of systems of rectangular co-ordinates, which are related to one another as object to image, or as the right hand is to the left hand. Here also the two arrangements are "insuperposable," and form two distinct systems. Since mathematical treatment extends to innumerable applications of all kinds in different branches of science, this relation of the object to its image is one of pretty general interest.

A Forest Service Circular on "Chaparral"

BULLETIN 85, entitled "Chaparral," by Fred G. Plummer, geographer of the Forest Service, is a publication dealing exclusively with a type of plant formation that has never before been made the subject of study. It is a work that is justly called the pioneer in its field. Chaparral is an Americanized term for a distinctive type of growth, which Mr. Plummer describes as a mixed forest of stunted trees, and is the result of peculiar climatic conditions. It forms an intermediate stage between a true desert and timberland. The author classifies wild lands into eight distinct types, as follows: desert, barren, grassland sagebrush, brushland, chaparral, woodland and timberland. The first four and a part of the fifth do not bear trees, the balance are forested areas. Chaparral is, therefore, a general term for a type of mixed growth of stunted arborescent plants, and is not, as is generally supposed, a name given to one particular species of plants.

The circular deals with the natural and artificial forces now in operation, which tend to limit or extend the range of distribution of chaparral forming species. This includes, not only historical records of past forest conditions in a chaparral region, but also a consideration of its present condition in relation to forestry and conservation. Here the chief topics are geographical conditions in the chaparral area; chaparral and the water supply; vertical range of chaparral; composition of chaparral; amount of shade produced, and the value of the different species. Although the central feature of the treatment is the effort to keep clearly before the reader the value of chaparral as a conservator of water, Mr. Plummer also discusses the commercial uses of



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some of the species for fuel, fencing, forage, bee-pasturage, etc.

The forester's point of view is also vividly illustrated in the chapters dealing with methods of protection against fire and artificial restocking of more valuable species after fires. Not only is the work entirely new in substance and its method of treatment, but it is fully abreast of the latest research, as shown particularly by the nomenclature of the species considered. The illustrations are numerous, wisely chosen and well executed. The pen drawings of the principal species of chaparral are excellent and all the half tones are clear. The addition of a small map engraved in colors, showing the distribution of chaparral, is a unique and valuable feature of the illustrations.

While this bulletin is intended primarily as a work for foresters in western United States and for forest students in general, and will probably be read, chiefly by technical foresters, nevertheless its readable style, choice and arrangement of subjects and emphasis laid upon scientific accuracy, cannot fail to commend the publication to any one who may be interested in reading the story of our large areas of stunted forests in the West.

The Current Supplement

IN the companion issue, No 1860, of our SUPPLEMENT, Harold J Shepstone contributes an article on the Potter's Clay Industry.—A very interesting suggestion for a new method of estimating the duration of geological ages is made by Mr Arthur Holmes.—We bring some new information regarding that important modern development, the Diesel engine, as applied to marine use.—The electrolytic smelting of iron has for some time been attracting attention. Consul L. J Fuller, of Gothenburg, Sweden, reports on the production of pig iron by electricity.—The application of metallographic diagnosis to the effect of mechanical treatment on the structure of metals is discussed by our Paris correspondent.—The fifth instalment of *Donald Murray's* article on Printing Pictures appears in this issue.—The electric locomotive for the line running through the tunnel in the Lotschberg is described by our English correspondent.—Mr Feldhaus gives us an illustrated account of the "Evolution of the Umbrella."—Prof Wiener discusses some of the dangers of aeronautics, and remedies against them.—R A Smith gives an account of the highways which the Romans built through and about the present site of London.—A. E Outerbridge discusses the uses and limitations of manganese and silicon in foundry practice.

An Exhibition of Labor-saving Appliances

THE United States Government Exhibit of Labor Saving Office Appliances was held on two floors of the Union Building in Washington city, July 6th to 15th, and the display is said to have equaled those of the Madison Square Garden and the Chicago exhibit of last March. Being held under government auspices the display involved no cost to the exhibitors for space, light or heat and the large market promised by the government service attracted manufacturers from all directions, the articles exploited ranging from lead pencils to the most complicated forms of apparatus employed in office work. Good attendance was assured as government employees received tickets for the exposition and were granted leave for the purpose of attending and opportunities were afforded for their recommending such appliances as appealed especially to them. Of the hundreds of appliances shown, it is doubtful if there is a single one which would not find a useful place in any large office establishment.

Exchange Professor in France.—The exchange of professors recently arranged between Harvard University and the French Ministry of Public Instruction goes into effect next winter, with W. M. Davis (recently exchange professor in Berlin) as the first exchange professor in France. Prof Davis will lecture on land forms. Prof Diehl, of the Sorbonne, will lecture on Byzantine history at Harvard.

Electricity

Fiftieth Anniversary of the Dynamo.—Fifty years ago Sr. Antonio Pacinotti invented the first commercial type dynamo. This event is soon to be celebrated in Pisa. At the time he invented the dynamo, Pacinotti was a student at the University of Pisa. He used a ring armature of the type now known as a "Gramme ring," having been reinvented by Gramme in 1870. It was not until 1881 that Pacinotti's dynamo attracted much attention, when, at the Paris Exposition, a diploma was awarded to the Italian inventor.

Railroad Car for Transformers.—A striking illustration of the enormous size of some of the transformers made in these days is shown by a new type of car built for transporting these transformers by rail. The car referred to is provided with a cut-out at the center, so that the floor is brought to within two feet, two inches of the tops of the rails, this being necessary to give sufficient clearance under bridges. The car is 35 feet 5 inches long, and in the cut-out portion will carry a load of 150,000 pounds.

Street Lamps of All Kinds in Chicago.—Figures given in the recent annual report of the Department of Electricity of Chicago, and quoted by the *Electrical World*, show that the total number of public street lamps in service on December 31st, 1910, was 37,994. Of these, 12,868 were municipal electric-arc lamps, 693 rented arc lamps, 11,980 gas-mantle lamps, 5,426 gas flat-flame lamps and 7,319 gasoline lamps. The cost of rented arc lamps is $75 a year, municipal arc lamps $61.96 a year, mantle gas lamps $18.91, open-flame gas lamps $15.41, and gasoline lamps $26.40.

An International Electric Railroad.—An electric railroad is to be built which will run in three countries, Italy, Switzerland and Austria, and it will greatly shorten up the distance by rail from Milan to Munich. On the Italian side it starts from Tirano, which is the terminus of the Valtelina electric road, and crosses the Swiss frontier by a five-mile tunnel through the mountains, reaching the Munster Valley. It then crosses into Austria to Mals, and this point will be connected to Landeck by a line which the Austrian Government is to build. This latter point lies on the railroad leading to Munich. It is probable that an electric section will be also run from Landeck to Munich.

Energy Generated in London and in New York.—The returns issued by the London County Council, and quoted by the *Electrical World*, relating to the amount of electricity generated in and around London, show that in London the borough councils generated or purchased 91,851,181 kilowatt hours, of which 75,115,968 kilowatt hours, or 82 per cent, were sold. Information regarding the kilowatt-hours generated by the London companies is not available, but they disposed of 137,211,288 kilowatt-hours. Whether this included that used by the railways is not stated. In New York city the amount of energy generated by the public-utility companies last year is estimated to have been 1,750,000,000 kilowatt-hours.

Mechanical Annuator.—A novel "current gage" has just been invented, which is designed to give a fair approximation of the current flowing through a conductor without cutting the conductor or interfering with its operation in any way. The device consists of a U-shaped magnet of laminated soft iron, secured to a handle, an arm is fulcrumed to the handle with one end serving as an armature directly over the poles of the magnet, and the other is fitted with a leaf spring engaged by a set screw on the handle, whereby the armature may be moved into or out of engagement with the poles of the magnet. If it be desired to measure the current in a conductor, the U-shaped part is placed over the conductor, and is electro-magnetically energized thereby. The set screw is then turned to force the armature away from the pole and when it has been moved far enough to spring away, the number of amperes passing through the conductor will be indicated by a hand on the set screw, which sweeps over a graduated dial.

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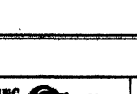


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Science

International Aeronautical Congress.—The fifth international aeronautical congress will meet at Turin October 25th to 31st, 1911, under the presidency of Commandant Renard. The last congress met at Nancy in September, 1909

A Language of 300 Words.—In the more inaccessible parts of the Sierra Madre Mountains, in northern Mexico, live a curious people called the Tarahumaris Many of them dwell in caves, but they have also small villages, all of them about 8,000 feet above sea level The Tarahumaris are small in body, but possessed of much endurance Their only food is maize, and they manufacture a drink called teshuin, from the same cereal Their language is limited to about 300 words, and they cannot count beyond ten.

Color-changing Paints.—Members of the Physical Society in London were greatly interested at a recent meeting by an exhibition of specimens of paints which change their color with variations of the temperature One of these paints is red at ordinary temperatures, but turns black in a few seconds when warmed in front of a stove or otherwise heated to 206 deg F Another paint is yellow until heated to a temperature of 113 deg F, when it becomes dark red They are called "heat-indicating paints" but are little more than scientific curiosities

Contaminating Gases Turned to Use.—An instance of the transformation by scientific means of a deleterious into a useful substance is furnished by a process employed in Germany in connection with the manufacture of superphosphate fertilizer where apatite is used The large volumes of hydrofluoric acid that are given off seriously contaminate the atmosphere, but by the German process these gases are recovered in the form of fluosilicic acid, which is used in the manufacture of artificial stone for hardening soft limestone and sandstone, and for other purposes

Filtered Water in Bamboo Stems.—Yapp, the English naturalist who has explored the mountain ranges of the Malay Peninsula, reports the fact, not generally known, that in several species of bamboo the hollow internodes—the parts of the stems between the joints—are stored with large quantities of naturally filtered water The knowledge of this fact might be of great service in an emergency Mr Yapp also discovered, on his last visit, two species of ferns, growing on trees, whose thick, fleshy stems are filled with galleries tunneled by ants, the ferns thus forming living nests for the ants

The John Scott Medal for McFarlan Moore.—Mr D McFarlan Moore has been awarded the John Scott Legacy Medal and Premium by the city of Philadelphia upon the recommendation of the Franklin Institute. The award is made in recognition of Mr Moore's scientific investigations in the development of the art of vacuum tube lighting, covering a period of many years Mr. Moore's system, as our readers know, consists briefly in converting electrical energy into light by passing an alternating current of electricity through rarefied gases in glass tubes By a variation in composition of the gases in the tubes, and the degree of their rarefaction, the color and intensity of the light produced are controlled.

Fever in Plants.—Not only animals but plants may suffer and die of fevers, is the conclusion reached by the French savant Du Sablon When a human being has a fever he loses flesh on account of the increased combustion, the quantity of carbonic acid respired from the lungs being augmented from 70 to 100 per cent A plant attacked by a fever, which may be caused by a wound, rapidly consumes its reserves of organic matter and becomes enfeebled, sometimes sufficiently to cause its death Du Sablon has experimented with potatoes rendered feverish by cutting them. The temperature soon rises about one degree, and the quantity of carbonic acid given off increases several hundred per cent. If the potato survives, its "respiration" after a few days becomes normal, but it falls into an enfeebled state, resembling that of a person convalescent from a long fever.

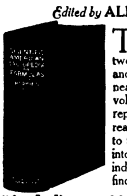
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Circulation

VIEWED FROM BEHIND THE SCENES

Why forced circulations are not worth one hundred cents on the dollar—Advertisers need to know not only how much the circulation is, but also how it was obtained.

By HENRY H. HOWER
Advertising Manager, The F. B. Stearns (Automobile) Co

Slowly, but as surely as the passing of time, a new idea is making itself felt in advertising That idea consists in paying for circulation according to the quality of the publication and its readers—not simply paying for so many sold copies The time is steadily passing when so-many-thousand readers for such-and-such a rate can get any and all business Thinking men are realizing the fact that the hundreds of thousands wasted in advertising can be diverted into producing channels On every side this idea is cropping out

A few years ago—and to-day in many cases—very large circulation meant heavy advertising patronage In some cases this was justified, but very often it was quite the reverse. More and more advertising managers are commencing to think more deeply and to analyze statements which before they had taken for granted

Probably the best example of this class of advanced thinker is E. St. Elmo Lewis Mr Lewis is outspoken in his denunciation of the old method "It is the most erroneous idea in advertising," Mr Lewis said, recently "There is no sense in buying circulation merely as circulation—it is what composes that circulation that counts I wouldn't give two cents for a hundred thousand circulation if I had no way of knowing or finding out something *about* that circulation"

There are publications of 50,000 in this country whose columns are worth more to the majority of advertisers than others of double, and even treble that figure Personally, I would willingly pay *twice as much* for space in the former as in the latter. And the time is coming when *valuable* circulation—among *quality* readers—will win its own battle

Listen Several years ago I became connected with a small semi-trade paper in an executive capacity Shortly after taking up my work, there came one day the representative of a "subscription and circulation bureau" To cut a long story short, he offered to get me *as many thousand subscriptions as I wanted* in any State or States desired—to deliver them within sixty days and to conform to the post-office regulations. All this without any effort on my part, but with considerable expense Suppose all this had been done—the circulation boosted to ten or fifteen thousand—aggressive advertising men put in the field The business would have come in, without doubt

How is the advertising manager to know that some of the various publications he is using are not doing these very things? This may seem an extreme position, and it is doubtless open to criticism, but there is more truth in it than many will care to admit

I know of a certain publication selling for something like fifty cents a year which has recently secured contracts for automobile advertising Cannot the wisdom of the selection of such a medium as this be criticised?

A little test I made of a large list of publications shook up my ideas in a good many ways But above everything else I found that there was a greater difference between well-known periodicals than I had dreamed of before The idea of paying for *the quality* of the publication and its readers means a good deal more to me now than it did then

And one thing more Quality circulation cannot be forced A publication of little merit cannot get—*and hold*—such readers It's the genuine merit of the publication that is responsible and there is nothing in a strong drift toward those publications which have the merit.—*From Printers' Ink, July 6, 1911.*

HARPER'S MAGAZINE

Thirty-five cents a copy Four dollars a year

If you care to know more about this—write

Overland

30 Horse-Power Five-Passenger Fore-Door Touring Car—$900

A MONTH ago we made the first announcement of this car. Our prediction came true. The entire industry sat up and had a good look. The day of that announcement dealers wired from almost every section of the country. They came to the factory in droves. Agents that last season bought 100 cars this year contracted for 150 and 200. The dealers from the metropolitan centers advanced their orders in proportion. Others that formerly contracted for 1000 cars signed up for 1500 for 1912. In one week we signed up nearly 8000 cars. One of our dealers alone takes more cars than most manufacturers turn out in a year. For the coming season eighteen hundred dealers throughout America will handle the Overland line.

This car is now ready for demonstration. If the Overland dealer in your town hasn't received one he will in a few days. Wait and see it. To fully understand the exceptional value of this car you have but to compare it with what the entire market has to offer for 1912. Study the specifications below carefully. In what other car will you find such value at such a price? What machine under $1250 can you line up against this and item for item see so much for so little money. When you stop to consider the fine, thorough construction—the heavy drop forgings—the pressed steel frame—the selective transmission fitted with F. & S. annular bearings (which the most expensive cars in the world use)—the 30 horsepower motor, the big wheel base, the fore-door body with door handles and all levers inside the car, you can better realize what an actual advanced manufacturing step this new car is. It is doubtful if any one ever expected so much in an automobile for such a small price.

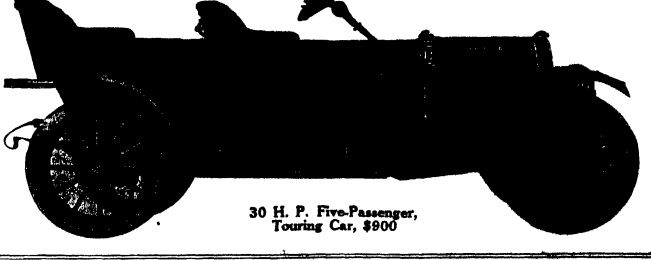
We urge upon anyone who feels at all doubtful about this statement to take the announcement of any other standard maker and see what he has to offer. Just make a few straight comparisons. Take any other car—compare the wheel base—the size of the motor—the body—the design—the finish—the seating capacity. See if you can purchase this car below $1250. And go further than that—find out how the other cars are made and what they are made of. This will reveal some interesting facts about the economical manufacturing strength of the Overland organization.

Our 1912 catalogue is now off the press. It explains exactly why no other maker in the business can produce this car to sell at this price without losing money. Write for a copy today.

SPECIFICATIONS OF MODEL 59

Wheel base, 106 inches; body, five-passenger fore-door touring, motor, 4x4½; horse-power, 30, transmission, selective, three speed and reverse, F. & S. annular ball bearings, ignition, Dual, Splitdorf magneto and batteries, front axle, drop forged I-section, rear axle, semi-floating; wheels, artillery wood, 12-1½ inch spokes, 12 bolts each wheel; tires, 32 x 3½ inches Quick Detachable; frame, pressed steel; finish, Overland blue; equipment, three oil lamps, two gas lamps and generator; tools, complete set; price, $900.

The Willys-Overland Company, Toledo, Ohio



30 H. P. Five-Passenger, Touring Car, $900

SIXTY-SEVENTH YEAR

SCIENTIFIC AMERICAN

THE WEEKLY JOURNAL OF PRACTICAL INFORMATION

VOLUME CV. NUMBER 10] NEW YORK, SEPTEMBER 2, 1911 [10 CENTS A COPY $3.00 A YEAR



This dramatic photograph was taken from the cofferdam wall, from a point dead astern of the "Maine," when the wreck had been partially unwatered Captain (now Rear-admiral) Sigsbee and his officers were in this portion of the ship at the time of the explosion. It remains to-day structurally intact

THE "MAINE," NOW PARTIALLY EXPOSED, ENCRUSTED WITH BARNACLES, AFTER THIRTEEN YEARS UNDER WATER.—[See page 210.]

SCIENTIFIC AMERICAN

Founded 1845

NEW YORK, SATURDAY, SEPTEMBER 2, 1911

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The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are striking, the articles short, and the facts authentic, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

The purpose of this journal is to record accurately and in simple terms, the world's progress in scientific knowledge and industrial advancement. It seeks to present this information in a form so readable and readily understood, as to set forth and emphasize the inherent charm and fascination of science.

The Mystery of the "Maine"

PRESIDENT TAFT, in asking for an additional appropriation of $250,000 to complete the work of unwatering and disclosing the wreck of the Maine, undoubtedly voiced the opinion of the nation at large when he said: "As long as there remains unexcavated any portion of the mud and debris within the wreck or in its neighborhood, from which evidences may be had of the original cause of the disaster, we shall be derelict in our duty if not prosecuting a further research."

Interest in the extraordinary operations which are being carried on by our army engineers in Havana harbor in the effort to solve the riddle of the "Maine" is more than national. It is world-wide. Both as an engineering work of unusual difficulty and as a determined attempt to get to the bottom of a mystery which is without parallel in naval history, the work which we illustrate and describe on another page of this issue is of profound interest, and the question will naturally arise at this stage of the proceedings as to what promise is afforded of determining with certainty whether the "Maine" was destroyed by an explosion from without or within the ship, and whether the disaster was deliberately planned, or resulted from accidental causes.

The work so far done seems to render the problem more perplexing than ever, for the unwatering of the ship has shown that the destruction of that portion of it where the explosion occurred was even more complete than was supposed. The examination made by divers immediately after the disaster showed that for a length of 70 to 80 feet the sides and decks of the "Maine" had been literally blown to pieces. The double bottom, badly broken up and twisted out of shape, was apparently more or less in place, and it was largely upon the testimony of the divers that portions of the double bottom showed that the plating was bent upwards and into the hull, and that a portion of the keel and bottom had been forced up to a point about 30 feet above where it would be had the ship sunk unimpaired, that the naval court of inquiry found that "the Maine was destroyed by the explosion of a submarine mine, which caused the partial explosion of two or more of the forward magazines."

In the intervening thirteen years, the wreck of the "Maine" has sunk many feet down into the soft mud of the harbor bottom. Judging from the photograph shown on pages 210 and 211, the keel and double bottom in the region of the explosion must have sunk even further than the wreck itself; else this portion of the wreckage would be visible, where the photograph shows an absolutely clear space. It is stated (though we have no official confirmation of this) that soundings in the region of the gap failed to show the existence of the double bottom. It is conceivable that, becoming detached from the rest of the wreckage, its weight has carried it slowly down to the underlying firmer bottom of the harbor, some sixty feet below the surface of the water. In this case, its recovery and thorough examination will prove to be a matter of extreme difficulty. Failing its recovery, the question as to how the "Maine" was destroyed must forever lack a definite and convincing answer.

The mystery of the "Maine" is to-day as profound as ever. Every hypothesis that has been offered presents insuperable difficulties. The suggestion that the deed was done by the Spanish government through its naval or military officers has, from the very first, been scouted by the naval and military men of the United States, who point to the fact that the Spaniards are a proud and a high-minded people, whose naval and military men are above all suspicion of so foul an act as the sinking of the ship of a friendly nation. Furthermore, the events of the war showed the Spaniards were woefully inefficient in the handling of mines and torpedoes, as witness the case of the battleship "Texas," which fouled a floating, Spanish contact mine with one of her propellers without causing it to detonate; furthermore, her mining and torpedo operations in general proved to be equally futile.

The suggestion that the "Maine" was sunk by Cuban conspirators in the hope of embroiling the United States and Spain is disproved by the fact that it would be impossible to lay a large mine in the area over which the Maine would swing at her mooring and connect it with two independent observation stations on shore, without attracting public attention. The mine would have to be carried out on a lighter or vessel of considerable size, moored in place, and electric cables paid out from the mine to an observing station, which would itself have to be connected by telephone with another observing station, each station being equipped with instruments to determine the exact moment at which the "Maine" was floating above the mine. The attempt to anchor a floating contact mine would present almost equal probabilities of detection.

Lastly, it has been suggested that the entrance to the harbor may have been mined, and that one of the mines may have broken loose or dragged its mooring, and come in contact with the ship, which was located, we believe, not very far from the harbor entrance. The trouble with this theory is that contact mines would scarcely be placed in a waterway where ships were free to come and go, and that, if the mine had broken adrift and was floating at the surface, the incurved plating which the divers discovered would have been the side plating at the water line, and not that of the double bottom.

There remains then the theory that the "Maine" may have been destroyed by an internal explosion, presumably of the magazines; but this suggestion is strongly controverted by the testimony of Capt. Sigsbee before the board of inquiry, which showed that on the fatal night everything connected with the ship was perfectly normal. The guncotton was stowed aft under the cabin, as were the torpedo warheads. The gun cotton primers and detonators were aft in the captain's cabin, and no torpedo was fitted with a warhead at the time of the explosion. As to the magazines, they were on that night at the normal temperatures for a tropical climate. There was no loose powder in the magazines. The magazines had been subjected to the regular inspection, the doors locked, and the keys were in the captain's cabin (from which they were recovered after the ship sank) at the time of the explosion. The evidence on this point is strongly against the possibility of any malicious blowing up of the magazines.

There remains the theory of spontaneous combustion of the magazine powder. This is rendered unlikely by the fact that the gunpowder for the big guns was entirely of the brown prismatic type; which, as is well known, is one of the safest powders known, and is not subject to any chemical deterioration, such as occurs in the smokeless nitro-glycerin powders. Had the magazines that exploded contained big-gun charges of smokeless powder, it is conceivable that spontaneous combustion such as, a few years ago, destroyed the French battleship "Jena," might have wrecked the "Maine."

On the other hand, the evidence shows that there was a small arm ammunition locker forward, and that it contained a new supply of ammunition for small-arm and small rapid-fire guns. This was presumably of the smokeless variety, and this fact will naturally raise the question as to whether the mischief might have originated at this point.

A Record Aeroplane Tour

WHEN he alighted upon Governors Island at 2.38 o'clock in the afternoon of Friday, August 25th, Harry N. Atwood completed his long journey from Chicago in triumph and established a new record for long distance travelling by aeroplane. He started from St. Louis at 8.05 A.M., August 14th—12 days before—and, flying from 40 to 150 miles each day, he completed the 1,265-mile trip without difficulty or serious mishap. His journey is the longest ever made across country by aeroplane, and the first real pleasure tour. Atwood was able to fly every day, and each day he made headway, although on a few he was obliged to wait until late in the afternoon for the wind to die down. His longest day's flight was 286 miles made the first day and his shortest 27 miles made the last.

When he passed Rhinecliff, N. Y., at 8.39 A. M., the day before he finished, Atwood was 18 miles ahead of the long-distance record of 1,164 miles made in 80 days in a circuit race in Germany. The European circuit aeroplane race was only about 1,000 miles in length and it required nearly a week longer than the time required by Atwood. The circuit of Britain race, 1,060 miles in length, although completed by Lieut. Conneau and M. Vedrines, in three days, was only finished by Mr. Valentine, on a French monoplane, and Capt. Cody, in his huge British-built biplane, in 13 and 14 days respectively. Thus it can be seen that Atwood surpassed their performances despite the engine trouble which delayed him considerably during the last three days of his trip. At one time, while he was nearing Albany, he was obliged to alight and tighten the bolts which secured the engine to the frame of the aeroplane. In ten minutes he was *en route* again. After circling about the capital city of New York State he was compelled to descend at Castleton, a few miles further down the river, on account of the burning out of a bearing in the motor. After rebabbitting this bearing over night, he made a fine flight down the river, dipping suddenly and passing under the Poughkeepsie Bridge, and circling over the parade ground at West Point, but he did not land on the parade ground owing to his fear that he could not start from the field successfully because of the trees and buildings surrounding it. Instead he alighted high up on the other side of the river, at Garrisons, replenished his fuel, and started for New York. When at Nyack, a half hour later, the motor suddenly gave out and he was obliged to find a landing place quickly, as he was not at a very great elevation. Dexterously guiding his machine, he alighted on a narrow patch of open field between a barn and an apple orchard. The motor was repaired overnight, and the next day, despite the thorough soaking which the aeroplane received in a heavy rain the night before, Atwood was able to make the trip successfully under lowering skies and with a strong wind at his back. Under these weather conditions he was only 48 minutes in covering the 27 miles to Governor's Island.

The total flying time of the Burgess-Wright biplane used by Atwood was 28 hours and 31 minutes, which corresponds to an average speed of 44½ miles an hour throughout the long trip. The journey was accomplished in twenty flights of an average length of 68¼ miles. Every time the machine alighted and started again without mishap, and the fact that it was never damaged, even in the dangerous forced descent at Nyack, speaks well indeed for Atwood's skill as an aviator. His flight shows up well in comparison with the *London Daily Mail's* Circuit of Britain race and endurance test as, like the competitors in this English event, he did not change his engine or any essential part of the machine. Furthermore, he had several days of more difficult flying around the Great Lakes and above the Hudson, than was experienced by any of the aviators mentioned above in the British contest. While flying over the water was dangerous for Atwood, even with pontoons on his biplane, with a hydro-aeroplane such as Curtiss has devised, it would be preferable to follow rivers and canals, upon which a forced descent could always be made without danger.

The successful termination at New York of Atwood's tour has shown America to still be in the lead as regards the practical use of the aeroplane for pleasure and touring purposes. While France has made a far greater use of it for military purposes, and England is taking it up for carrying of the mails, a young American with only a few months' experience in flying, has shown that it is possible to tour for pleasure and without danger in an American aeroplane, fitted with an American motor. The lesson taught by the motor troubles which he experienced is that for safety a touring aeroplane should be equipped with two separate engines, so that in case of failure of one, the other can be used. Mr. Edwin Gould foresaw this necessity two years ago and offered a generous prize of $15,000 through the SCIENTIFIC AMERICAN for a twin-motor aeroplane. Already one American monoplane has been built and flown with two motors, and several machines of this type, we understand, have also flown abroad. The Gould prize is still open for competition, and we hope that by July 4th of next year, at least half a score of aeroplanes will be built to compete for it.

Hospital Cars of the Swiss Federal Railways

Carrying the Sick by Rail

By Dr. Alfred Gradenwitz

THE Swiss Federal Railways have recently added to their rolling stock several hospital cars, which are intended for the conveyance of sick and invalid travelers, and whose equipment represents the most modern development in this direction. The cars are placed at the service of private parties, and being intended especially for long journeys, they are fitted out with all the technical equipment to adapt them for travel over the various European railway systems.

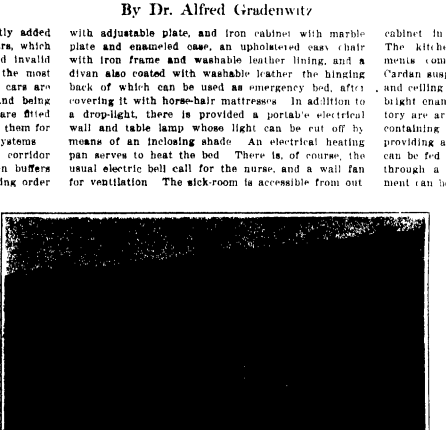
The hospital car is built as a four-axle corridor carriage with two bogies, its length between buffers being 63½ feet and its total weight in working order 41¼ tons. Not only is it fitted to travel on all standard-gage railway lines of the Continent, but it is designed also for transfer on the Scandinavian and Sicilian ferry-boats.

In addition to the brakes ordinarily in use on Swiss railway lines—namely, an automatical Westinghouse emergency brake with a braking cylinder of 8,800 pounds normal piston pressure, combined with a Westinghouse regulating brake there is provided a Hardy switching vacuum emergency brake with two cylinders of 3,080 pounds lighting power each, which are designed for automatic working as well as for direct manipulation. As French railways still use emergency chains for safety couplings—the hose couplings of the two Westinghouse brakes being located between the chains—three pairs of Westinghouse braking hose had to be arranged at each end of the wagon. The brake can also be controlled by means of a hand-wheel from each platform. In each compartment in the car and also in the passage, there is a safety brake, with one handle for actuating both the automatic Westinghouse brake with the signaling whistle and the electrical interconnection signal of the Paris-Orleans Railway or the automatical Hardy brake. In addition each wagon is fitted with the Prudhomme electrical interconnection signal of the French and Belgian Northern Railways, the alarm bell line of German Prussian and the holders for the alarm cord prescribed by Austrian railways. Ten signal holders of different designs had to be put in so as to comply with the special regulations of each of the railways on which the car is intended to travel.

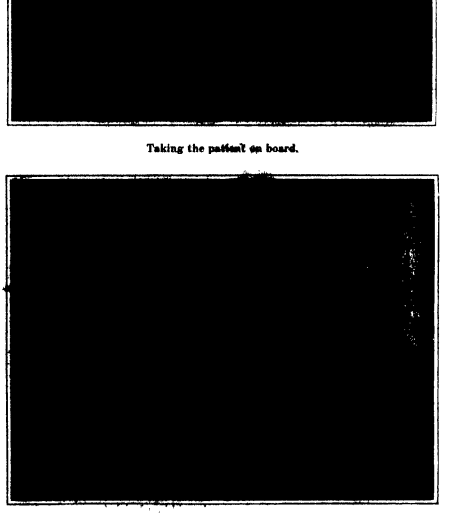
The car is heated by steam circulating in smooth tube radiators with Wilheim regulators in general use on the Swiss Federal Railways. In order to insure a satisfactory gradation of heat, a radiator with Jenkins's regulating valve is provided in the sick-room. A hot air heating installation on the Pape-May system serves to heat up the car when stalled or before starting or when traveling lines not equipped with steam heating. All the various compartments of the car are electrically lighted on the Brown, Boveri & Co system the total candle-power being 272. The dynamo driven through belt transmission from one of the car axles in conjunction with eight accumulator batteries of 1,600 watt-hours each, also supplies electrical energy for various apparatus with which the car is equipped.

The sick-room, which is located in the middle of the carriage, and the adjoining lavatory, are fitted up aseptically in the same manner as up-to-date hospital rooms, all the walls, ceilings and floors, as well as the furniture, being readily washed and disinfected, while all the angles of the walls and ceiling are rounded off and any joints covered over with smooth nickel-plated metal rods. The walls and ceilings are painted with white enamel and simple decorative patterns. Extensive use has been made of glass, porcelain, marble and nickel-plated metal. The floors are fitted with inlaid linoleum.

The sick-room contains a good bed with iron frame and steel mattress and a removable nickel-plated lifting device. The horse-hair mattresses are made in three parts to facilitate disinfection; a chest of drawers fitted into the wall contains several changes of bed linen. The sick-room further contains a bed-table with adjustable plate, and iron cabinet with marble plate and enameled case, an upholstered easy chair with iron frame and washable leather lining, and a divan also coated with washable leather the hinging back of which can be used as emergency bed, after covering it with horse-hair mattresses. In addition to a drop-light, there is provided a portable electrical wall and table lamp whose light can be cut off by means of an inclosing shade. An electrical heating pan serves to heat the bed. There is, of course, the usual electric bell call for the nurse, and a wall fan for ventilation. The sick-room is accessible from out side through broad folding doors in the side-walls, through which the invalid can be brought in on a stretcher or Sedan chair.



Taking the patient on board.



The sick-room of the hospital car.

Adjoining the sick-room are the quarters for the attending physician or nurse. The furnishings here include sleeping accommodation and an upholstered seat coated with washable leather, further a folding table and a metal and plate glass cabinet for medicines surgical instruments dressing, etc.

A first-class compartment for the patient's relatives or friends is attached, this also being equipped as a "wieeper."

The seats are lined with bright gray cloth to match the carpet. All metal parts throughout the carriage are nickel-plated.

The kitchen is equipped with an ice-box for food and drink and to store ice for medical use; there is a marble topped table and a fire-clay sink on nickel brackets with self-locking water faucet. Under the kitchen table there is a small chest of drawers for polishing utensils and on top of the ice box a crockery cabinet in which the kitchen linen is also kept. The kitchen is operated electrically, its arrangements comprising two quick-acting radiators with Cardan suspension and a toasting pan. Both the wall and ceiling are lined with slate iron and painted with bright enamel. Over the kitchen as well as the lavatory are arranged water tanks of tinned copper plate, containing a total of about 1,000 liters of water, thus providing an ample water supply. These water tanks can be fed directly from the roof or from underneath through a pressure conduit. The baggage compartment can be heated and contains a folding bench for domestics. A special lavatory is provided for general use. The passage also contains an upholstered hinging seat for domestics.

All the sliding doors of the carriage run on ball bearings.

Four carriages of this type, constructed by the Schweizerische Industrie-Gesellschaft of Neuhausen, have so far been placed on the tracks.

The Completion of Hann's "Climatology"

HOFRATH Prof. Dr. Julius von Hann, the venerable and venerated Austrian meteorologist, has just published the third and final volume of a revised and greatly enlarged edition of his "Handbuch der Klimatologie." The first edition appeared in 1883, the second in 1897, and the first volume of the third edition, just completed, in 1908.

Although dealing with a subject of universal interest, viz. the climates of all parts of the world, this work has for many years enjoyed the position of being sui generis. Since the appearance of Woeikow's "Klimate der Erde," in 1887, no other work discussing this subject in detail has appeared, in any language. The climatologists of the world appear to have recognized that Hann was better able than any one else to handle the subject adequately and have left him the undisputed master of the field. His manner is encyclopedic. Reading omnivorously and writing with unflagging industry in spite of advancing years, he has produced a digest of nearly all the existing literature of climatology and climatography, a fitting companion piece of his "Lehrbuch der Meteorologie" published in 1901 and in a more condensed form in 1906. The "Klimatologie" like the "Meteorologie" is however more than a digest. It is also an indispensable bibliography, as it contains thousands of references to the literature on which it is based. Moreover those references are not confined to scientific literature; popular books of travel for example have been laid under heavy contribution.

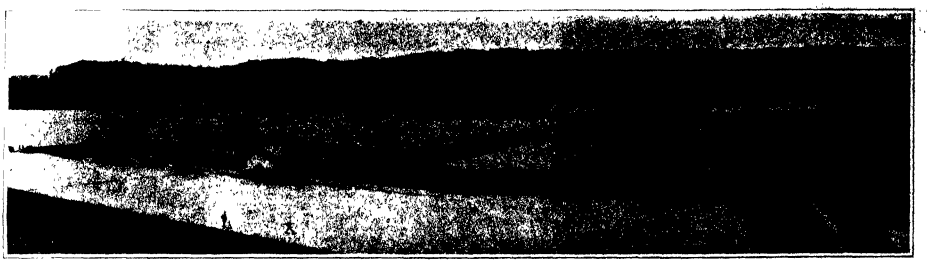
An English version of Hann's unique work is sorely needed. In 1903 Prof. Ward, of Harvard, published an admirable translation of the first volume of the second edition, but this deals only with climatology in general not with the climates of particular countries.

Niagara and Victoria

WHAT is the true comparison between the power of Niagara and the Victoria Falls in South Africa?

The answer is that the flow at Niagara varies between 62,000,000 and 161,000,000 gallons per minute, that at Victoria is as low as about 5,000,000 gallons in August.

The mean available drop at Niagara is 160 feet and at Victoria 380 feet. Hence, while the maximum Niagara flow represents about 3,000,000 horse-power, the Victoria flow in August represents only 580,000 horse-power, and, accepting the statements of local authorities that in November the flow at Victoria drops to only 2,500,000 gallons per minute the minimum horse-power there can be only about one-tenth of Niagara's minimum. The maximum of Victoria is not given.



Bird's eye view of the Fernbank dam just opened in the Ohio river near Cincinnati.

The Largest Movable Wicket Dam

Providing a Nine-foot Boating Stage of Water in the Ohio River

THE largest movable wicket dam in the world and the only one built entirely of concrete and steel has just been opened for business in the Ohio River near Cincinnati.

When the steamboat "Indiana" passed through the lock on July 25th, as here shown, the event marked the completion of a six years' task in building one of the most remarkable dams, indeed, the only structure of its kind. No other dam is built entirely from concrete and steel.

There are 60,000 cubic feet of concrete in the structure, of which 35,000 feet is under water and cannot be seen at any time. All the gravel, sand and crushed stone used in this vast amount of concrete was excavated on the site of the big dam when dredges scooped out the river's sandy bottom down to bed rock where all concrete footings are planted.

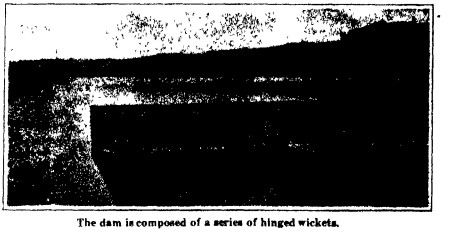
The foundation for the dam proper, extending across the river is of concrete and steel and arranged so that the movable wickets work independently of each other and may be removed like so many pegs from so many holes. The one illustration shows the government dredge boat beginning to stand the wickets in place in their sockets on the bed of the river. The long line of wickets forms the dam to hold back the water. The mechanism of the dam allows these movable wickets to be dropped flat upon the bottom of the river bed or raised at will by means of compressed air. These movements are controlled from the Ohio shore.

The working of the dam proper regulates the height of water in the 25 mile pool above it. When the river is high and there is no need of the artificial stage of water the wickets are lowered flat on the bed of the river and craft pass over as if no dam were there, but when the water is low and the stage of water is artificially formed above the dam the craft must pass through the lock on the Ohio shore from the higher or lower stage, or from the lower to the higher, according to the direction in which the boats are traveling, as illustrated in the photograph showing the steamer "Indiana" passing up stream through the lock canal along the Ohio shore. The government has appointed four lock keepers to transfer these boats through the big dam. These men work in shifts.

That the big Fernbank dam, known officially as No. 37, is a big success may be gleaned from the fact that the United States government will build others like it in the Ohio River to make that stream navigable the year round from Pittsburg to Cairo, a distance of more than a thousand miles. It is a step completed to establish a permanent stage of not less than nine feet of water in the Ohio River the year round. This dam located at Fernbank, Ohio, twelve miles below Cincinnati, will give Cincinnati a permanent minimum stage of nine feet of water for a distance of 25 miles. It cost the government $1,500,000. Early in September people of the Ohio Valley will gather in Cincinnati and the structure will be officially dedicated.



How the water pours through the Fernbank dam.



The dam is composed of a series of hinged wickets.

The Pebble Industry

A PECULIAR form of mineral wealth is found on Plum Island and Goose Island, two of a row of islands lying between the northern point of Long Island and Watch Hill. It consists in heaps of richly-colored quartz pebbles, showing red, yellow, purple, and other hues, which are locally called agates. They are used in making stained-glass windows, and there is a sufficient demand for them in New York to keep the owners of one or two sloops employed in gathering them from the beaches, where the waves continually roll and polish them, bringing out the beauty of their colors.



The gate is mounted on wheels like a freight car on a track like that of a railroad.



Government dredge setting the wickets in place.

THE LARGEST MOVABLE WICKET DAM

The Isolation of an Ion

Measuring the Smallest Thing in the World

By William J. Humphreys, U. S. Weather Bureau

JUST as the accurate measurements of controlled phenomena have taught us much that is definite and much that is useful about the divisibility of matter, so also cleverly designed and skillfully executed experiments are giving us equally definite knowledge of the atomic nature of electricity, of the fact that there is a measurable and seemingly ultimate limit to the divisibility of an electric charge, and what the exact magnitude of the ultimate charge is

Like nearly every other discovery of importance, this one, too, has a long and an honorable history. In fact it can be traced back, step by step, almost a century.

The first, and in many ways most fruitful contribution to this subject, was made by that prince of experimenters, Michael Faraday. It consisted in proving that when an electric current is passed through a water solution of any one of certain substances, the substance itself is taken out of the solution, to an extent dependent entirely upon the quantity of electricity so passed, and upon the nature of the substance dissolved. Thus, when the same current is passed in series through the water solutions of several salts, such as sodium chloride, silver nitrate, copper sulphate, and the like, the weight of the metal deposited, or, under proper conditions, permanently removed from the solution, is directly proportional to the atomic weight of the metal itself, and inversely proportional to its valency, that is to say, to the number of hydrogen atoms necessary chemically to take the place of one atom of the metal. This proportionality between the quantity of electricity passed through the solution, and the resulting amount of chemical decomposition, holds rigidly true, within the limits of experimental error, under all conditions, and hence it seems practically certain that to each ion in a solution conveying an electric current there belongs a definite electrical charge, and that the smallest of such charges is that carried by a single hydrogen atom, or by a single atom of any other univalent substance. A bivalent atom, such as copper in copper sulphate, carries just twice the smallest, or univalent charge, a trivalent atom three times the smallest charge; and so on for atoms of still higher valency. Hence, in electrolytic solutions there is a measurable "smallest possible charge," of which large electrolytic charges are only definite multiples.

A natural inference from these experimental facts would be (and this inference was drawn by many) that electrical charges are just as definitely atomic in their nature as, for instance, is a mass of iron. That just as, under given conditions, there is a limit to the actual, though not to the conceivable divisibility of matter, so too there is a limit to the actual, though again not to the conceivable divisibility of an electric charge. This, however, was only an inference, and for many years the way to test it, in the case of any quantity of electricity other than that used in the decomposition of an electrolyte, was not evident. Besides, even in the process of electrolysis, the most refined measurements could directly detect nothing less than the aggregate of countless millions of elementary charges, so that the value of the unit charge was only inferentially and not immediately determinable.

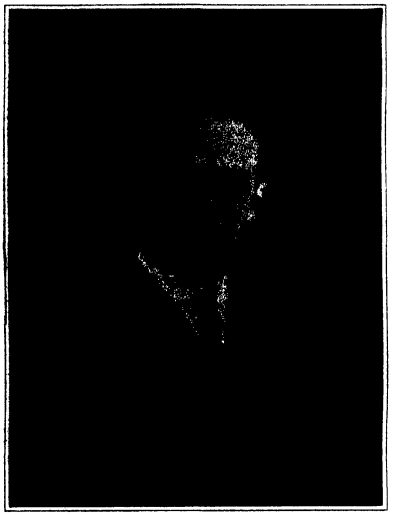
About a dozen years ago, J. J. Thomson, H. A. Wilson, and C. T. R. Wilson began, in the Cavendish laboratory at Cambridge, England, a series of most ingeniously devised and skilfully executed experiments that proved the existence of minute electrical charges in conducting gases, and showed their average value to be, as nearly as could be determined, the same as that of the electrolytic charge spoken of above.

C. T. R. Wilson showed that a fog of water particles will form in dust-free air whenever the degree of super-saturation is sufficiently pronounced. If the air is ionised, or has been rendered conducting through the action of X-rays, or otherwise, then a four-fold super-saturation causes condensation of the water vapor on the negative electrons; a six-fold super-saturation gives condensation on the positive electrons, and an eight-fold on the neutral molecules of the gas itself.

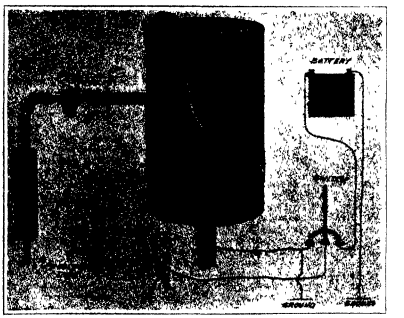
Now, a knowledge of the amount of water vapor present, and of the extent of the cooling below the dew point by which the super-saturation is produced enables one easily to compute the weight of the water condensed as fog. Furthermore, if the fog is left to itself, it slowly settles at a rate which, as Stokes proved long ago, depends upon the size of the individual particles and upon the viscosity of the medium through which they fall.

A measurement, then, of the rate at which the fog falls, since it all falls at about the same rate, enables one to calculate the size of the individual particle, and this knowledge of the size of the particle, together with a knowledge of the amount of water condensed, at once gives the total number of particles.

On bringing a charged body near this electrified fog its motion is modified, and a means is at hand for measuring the magnitude of the charge on each particle.



Prof. R. A. Millikan, who has isolated an ion and measured the ultimate unit of electric charge.



The apparatus by means of which Prof. Millikan has isolated an ion and measured its charge

Probably the simplest method of measuring this charge, through the behavior of the fog as a whole, is that devised by H. A. Wilson. The rate of fall of the fog is measured when there is no external electric field acting on it, and thus the size and weight of the individual particle determined. After this a vertically directed uniform electric field is brought to bear on the particles, and regulated to just counteract the force of gravity, so that the fog neither rises nor falls. Under these conditions of equilibrium the value of the charge on each particle of fog, multiplied by the strength of the field, is equal to the weight of the suspended particle; and hence when both the weight of the droplet and the strength of the field that keeps it in suspension are known the numerical value of the charge is also known.

All this, however, assumes that the rate of fall of the fog en masse, the group rate, is the same as would be that of a single one of its droplets if alone. This as a matter of fact is not rigidly true.

For this and for other reasons it seemed extremely desirable to Prof. R. A. Millikan of the Ryerson physical laboratory at the University of Chicago somehow to isolate and to measure an ion entirely by itself.

A few years ago it would have been almost silly even to have dreamed of accomplishing such an experimental feat. But Prof. Millikan has most cleverly solved this seemingly impossible problem, and by so doing probably has made by far the most accurate of all determinations of the value of this fundamental unit, the atom of electricity. Nor is this all, for the improved value of this unit carries with it correspondingly corrected values of other things such as the number of atoms per unit weight of any given element and the mass of the individual atom itself.

The full account of this ingenious and valuable investigation is given in the *Physical Review* for April of this year, and should be consulted by any one especially interested in the subject. In brief the process by which single ions were isolated and individually measured was as follows.

A fine spray of oil was blown by dust-free air into a dust-free chamber, the bottom of which was closed by a brass disk 22 centimeters in diameter. The center of this disk, which was perfectly plane on the under side, was pierced by a pin-hole through which an occasional oil droplet fell. Strictly parallel to this disk, and just 16 millimeters below it, was another brass disk of the same size. A band of thin ebonite was bound around the edges of the disks, while ebonite rods kept them fixed in position and also strictly insulated from each other. In this way a cylindrical air chamber 22 centimeters in diameter and 16 millimeters long was formed between the two parallel brass plates.

A parallel beam of light was passed through two diametrically opposite glass covered holes in the ebonite band, and hence immediately beneath the pin-hole in the upper plate. Through a third glass covered hole in the ebonite band a low power telescope was so focused as to show distinctly any object floating in the air immediately beneath the pin-hole. As soon as one or two droplets chanced to fall through this opening, and, therefore, into the field of the telescope, I was closed by an electromagnetically operated cover, so as to prevent, as far as possible, all disturbances due to air currents. Changes in the size of the drop were at most entirely eliminated by the use of substance that evaporate slowly, and by the additional precaution of having the volume of the cylinder through moistening its walls, already saturated with the vapor of the substance used.

The rate of fall of the droplet due to the force of gravity alone, was measured and in the way its size and mass approximately determined, as above explained. The plates were then charged to a known difference of electrical potential and hence the move

ment of the droplet if electrified, was changed The new velocity was measured and its direction noted These measurements with the electric field alternately off and on were repeatedly taken, but during the course of the observations it frequently happened that the droplet encountered and entrapped a free ion of one or the other sign, as was evidenced through its abrupt changes in velocity The more ionized the gas the more frequent the captures

By this process free gaseous ions of either sign have been captured at will, either singly or in multiples, and their magnitude has been so carefully measured, under conditions so free from assumptions, that the size of the electrical atom, the smallest quantity of electricity now attainable, is known probably to within one part in 500 of its actual value

Numerically this value is the absolute electrostatic unit multiplied by 4.891×10^{-10}, a quantity incomprehensively small To illustrate its excessive minuteness, let us suppose one hundred millions of people should begin to collect and count these atoms of electricity, just as Prof. Millikan has collected and counted them, only at the extraordinary rate of 100 every minute, and let them keep steadily at it until they had enough to generate by electrolysis sufficient hydrogen to fill a child's toy balloon of some eight inches diameter. Certainly this would not be enough electricity to consider in any commercial transaction, and yet it would take the above hundred million hustlers geological ages—in fact something like four millions of years—to collect it by the process described. Surely, then, the electric ion is small beyond comprehension, and its definite isolation and exact measurement stands forth as one of the cleverest, as it is also one of the most important, achievements of modern physics.

Correspondence

[The editors are not responsible for statements made in the correspondence column Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.]

The Right and the Wrong Way of Mining Coal

To the Editor of the SCIENTIFIC AMERICAN:

Dr Holmes's article upon the conservation of the coal resources was highly interesting, and from the viewpoint of the scientist leaves nothing to be desired It was, to my mind, the distinctive feature of your issue of August 12th, 1911 With your permission I would like to state a mere layman's side of coal conservation

To clearly convey my meaning I will use two mines about 900 miles apart The Blossburg Pa., coal region has five veins of coal, that of the Sullivan County, Indiana, region has seven veins of coal Now note the difference between mining systems

The lower drift at Arnot, Pa., has been worked since 1866 There was seldom less than 800 miners employed in it The workings extend over 22,000 acres and 96 per cent of the coal is taken from the workings In the forty-five years the mine has been worked but six men have lost their lives while digging coal, and an accident is a very rare occurrence That I term the correct method of working a coal mine

In Sullivan, Indiana, a coal mine has been worked seventeen years About 150 miners are employed The workings extend over 600 acres An average of seven men have been killed in it each year, while accidents are of almost daily occurrence That I call the incorrect method, for less than 60 per cent of the coal is taken out

The method of working at Arnot, Pa., is this All coal is both undercut and sheared by pick or machine, then a few ounces of powder brings down the coal without shattering the strata above, so that when the out-crop is reached the pillars can be drawn, thus leaving but three or four per cent of the coal behind

The freedom from death and accident is due to this. When the miner reaches his room he immediately takes his lamp from his head and cautiously raises it once in a while to see if the flame will denote the presence of fire damp If so he does not blow it out, but slowly puts it down on the ground and extinguishes the lamp by placing his coat over it When the miner reaches the "face" he takes a pick and sounds the roof to find out if there is any loose rock overhead If so, he either wedges it down or sets a prop under it Though the mine is full of coal dust no dust explosion ever took place in it

At Sullivan, Indiana the coal is "shot from the solid" Little or no undercutting is done Each miner uses at from five to ten pounds of dynamite or an equally strong explosive each day This not only loosens the coal, but shatters the roof also, so that if a vein of coal is above the one worked it is extra hazardous It does more It causes the almost daily accident and the loss of about 40 per cent of the coal in the mine It is rarely possible there to draw the pillars So the net result is the loss of 40 per cent of the mine worked the almost entire loss of the vein above and a continuous maiming and killing of the miners

Consider this matter in another way Supposing a half ton or more of dynamite were exploded in five and ten-pound charges in the streets of a city within one hour What would be its effects in the open? Apply this, then, to what must be the effect of the explosion of a similar amount in a mine where the effect of the explosion has but a single direction to expand. All this is to take place within the area of fifty acres

The method used in Indiana is in vogue all over the West It is wasting, criminally wasting, a large percentage of the most valuable of nature's gifts and causing a wholesale slaughter of men I edited the national official organ of the coal miners for seven years, and my observations extending practically all over the coal fields, taught me that there was but one way to prevent the slaughter of miners and the criminal waste of coal, to wit: To make it a penal offense to shoot coal from the solid or to attempt to get it without undercutting and shearing the "shot" with either pick or machine.

What would be the result? But one-tenth of the powder would do the work; there would be no dust explosions, for little dust would be made, the strata above would be practically unharmed, thus preventing the killing and maiming of miners and securing over 90 per cent of the coal.

That this is so is again illustrated by coal regions separated only by county lines, Allegany County, Maryland, where the method used is similar to that used in Arnot, Pa., with similar results, and Allegheny County, Pa., where the Indiana method is used and the same results ensuing.

When I stated these things in the miners' organ the operator would sneer at them because he wanted to get the greatest amount in the shortest time regardless of the wrong he was doing to the country and the injury to future generations Many miners indulged in somewhat heated criticisms of myself, for they, too, wanted to get the most for the least

Some day, some time, we will secure a legislator and a Congress with patriotism and courage enough to enact laws that will stop this devastation and the destruction of an asset incalculable in value

Blossburg, Tioga County, Pa. S M SEXTON.

Eugenics and the Conservation of Humanity

To the Editor of the SCIENTIFIC AMERICAN:

Conservation of American forests is important. So is conservation of American coal, and oil, and natural gas, and water supply, and fisheries But the conservation and improvement of the American race is far more important than all other conservation The real wealth of a nation is the quality of its people Of what value are endless acres of forests, millions of tons of coal, and billions of gallons of water, if the race is not virile, and sane and sound? You have shown a fine discrimination in including an excellent editorial on eugenics in your Conservation Number, and as one of your many readers I wish to thank you heartily for it Germany is ahead of us in her forest policy She is also ahead of us in her efforts to improve and conserve her people England is ahead of us, too, in the practical interest which is now taken there in the splendid work of the National Eugenics Laboratory of the University of London, and of the Eugenics Education Society. In the United States we are just beginning to take notice of the work of foreign investigators along eugenic lines, and slowly but surely the painstaking researches of Dr. Charles B Davenport, and of his colleagues of the Committee on Eugenics of the American Breeders' Association, are attracting attention and will lead to action.

Fearfully misguided has been most of our so-called philanthropy We have housed and clothed and fed the defective, the degenerate, the delinquent, to such an extent that we have encouraged them to reproduce their kind in ever-growing numbers. We have spent increasing sums for asylums, almshouses, prisons and hospitals, in which we have *temporarily* confined the insane, the pauper, the habitual criminal, the imbecile, leaving them free, during most of their lives, to propagate their kind It is a fact, disguise it as we will, that we have taxed ourselves to support institutions which have resulted in increasing, and not decreasing, the number of the unfit. We have before us an immediate duty, of tremendous importance, in caring for our own unfit; in seeing to it, by adequate legislation, that the insane, the habitual criminal, the feeble-minded and similar classes are *permanently* segregated, so that they cannot reproduce their kind to be a further burden upon the nation, and in enacting laws which shall prevent the marriage of those whose offspring will be unfit.

But, in addition to our own very heavy burden of those who are defective or degenerate, we are adding every year, by immigration, many hundreds if not thousands of aliens whose presence here will inevitably result, because of their own defects, or those of their offspring, in lowering the physical and mental and moral standards of the American race. We, in the United States, have a wonderful opportunity to apply eugenic principles, upon a scale which no other nation can begin to approach, in our power to select and regulate alien immigration. Unprejudiced experts are agreed that our present very liberal immigration laws do not suffice to preserve the *status quo*—physical and mental—of our population, and are very far indeed from promoting any improvement We are here forming a new race, extraordinarily heterogeneous in character, yet we are to-day taking more care to see that a Hereford bull or a Southdown ewe, imported for breeding purposes, are sound and free from disease than we take in seeing that the alien fathers and mothers of future American children are sound and strong and sane and fit Biologists admit that they have much to learn about heredity But of some things they are already sure. Enough is known to make it absolutely essential, if the quality of the American race is to be preserved, that there should be a far more careful selection of our incoming alien immigrants, on eugenic grounds, than we have ever attempted

The need is imperative for applying eugenic principles in much of our legislation But the greatest, the most logical, the most effective step that we can take is to begin with a proper eugenic selection of the incoming alien millions If we, in our generation, take these steps we shall earn the gratitude of millions of those who will come after us, for we shall have begun the real conservation of the American race

Silver Lake, N H. ROBERT DEC WARD.

Education and Success

To the Editor of the SCIENTIFIC AMERICAN:

Your article on the above subject in the issue of June 3rd appeared to me most admirable, and the conclusion that "your success is measured not by what the world gives to you, but by what you give to the world," one to be written in letters of gold

But is not the chief object of each one of us personal happiness? And how is the question affected when we consider personal happiness? Who are the happiest of human beings? After a long life, in which I have met and consorted with all sorts and conditions of men, I cannot help thinking that what Greville recorded—I write from memory—nearly one hundred years ago is true The men who pass their lives absorbed in personal ambition, personal aggrandizement, or personal pleasure, are *not* happy Those who live for others or seek their highest personal manifestation in labors to advance art, science, literature, and morality are happy.

If, then, the greatest success man can attain on earth is personal happiness, we again find that *"your success is measured not by what the world gives you, but by what you give the world."*

F C CONSTABLE, M.A.

Wick Court, near Bristol, England

Preservation of Niagara Falls

To the Editor of the SCIENTIFIC AMERICAN:

I take this occasion to compliment you upon your strong editorial stand for the preservation of Niagara Falls. Though everyone knows that the SCIENTIFIC AMERICAN is published for the scientific and the industrial arts, it is certainly refreshing to see a journal of your class have some feeling and regard for America's natural wonders.

These wonders, and particularly Niagara Falls, are national assets in more senses than one, because they draw together citizens from all parts of the country, and they also amass great wealth in the form of visitors to the localities possessing these wonders.

Therefore the wonders of America should be preserved, not only for sentimental reasons for all lovers of the beautiful, but also for the patriotic and financial reasons.

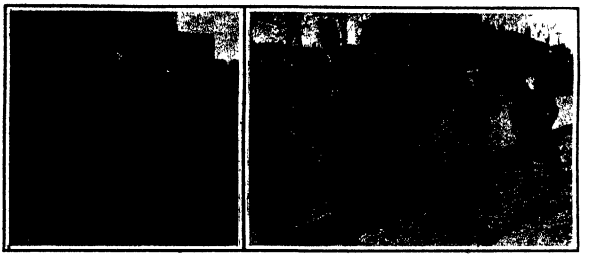
I trust that the SCIENTIFIC AMERICAN may be successful in its good work in stopping any further encroachments upon what is left of the beauty of Niagara Falls.

New York City. PALMER H. LANGDON.

Curiosities of Science and Invention

Track Inspector's Bicycle

IN order to lighten the work of the plodding trackwalker a French inventor has designed an attachment for a bicycle which will permit the machine to travel on the rails, thereby allowing the man who inspects the track and roadbed to cover a larger territory in a given time and with much less fatigue. The attachment is shown in the accompanying engravings. It consists of a pair of supplementary forks secured to the main forks of the front wheel and provided at their lower extremities with rollers adapted to bear on opposite sides of the rail. In addition to this there is a light steel frame secured to the main bicycle at the rear which carries at its outer end a small roller that rides on the opposite rail of the track. This serves to keep the two wheels of the bicycle on the rail without any effort of steering on the part of the rider. In order to permit the rider to preserve a comfortable position when traveling slowly around a curve that is steeply banked, the roller is made adjustable under control of a small hand wheel, whereby it may be thrown in or out so that the rider can adjust himself as nearly as he desires to the perpendicular. The roller frame may be detached at a moment's notice and secured to the bicycle in the manner illustrated, and the supplementary forks may be raised, permitting the wheel to be ridden over an ordinary road.



Fitted for road travel. In use on a railroad Track.

A track inspector's bicycle.

A Curious Indian Cantilever Bridge

SOME interesting examples of Indian ingenuity are afforded on the River Skeena and its tributaries in north British Columbia. These waterways in their upper reaches flow very swiftly and for the most part through deep ravines. As it is impossible for the Indians to cross them by means of canoes, they have resorted to bridging. Their bridges are interesting structures from the engineering point of view, inasmuch as the cantilever principle is adopted. The bridge of this design shown in the accompanying illustration spans the Bulkeley River where it is about 120 feet wide, and the height from the bridge to water level is about 80 feet.

It is built of wooden logs, the legs of the structure being formed of single stout logs varying from 60 to 80 feet in length. The task of lowering them into position must have demanded considerable ingenuity on the part of the builders. They are buried about 15 feet at their lower ends, and anchored by the superimposition of masses of large rock rolled and carried to the site. The longitudinal members of the shore spans are similarly buried in the ground and lashed to the ends of the diagonal legs. These main members, corresponding to deck girders, are about 120 feet in length, and to either end the A members of the superstructure are lashed. Elaborate cross bracing is resorted to in order to secure greater strength.

When the bridge was first erected the different members were simply secured together by willow thongs, but when the British Columbian government erected a more substantial suspension bridge lower down the river, the Indians assembled and followed the white man's operations with great interest. They observed how the thick wire cables were slung and anchored, and accordingly decided to introduce wire into their own structure. They procured the material for this purpose from wherever they could and introduced it in a most fantastic manner. Also when the Grand Trunk Pacific Railway engineers commenced working on their track near by the Indians procured odds and ends such as bolts and spikes from them for introduction in their bridge so that now it is a strange looking piece of work, though the fundamental cantilever lines are still distinct.



Cantilever bridge built by Indians in British Columbia.



A giant induction coil discharging across a four-foot gap.

A Giant Induction Coil

THE accompanying engraving illustrates one of the most powerful induction coils in existence, viz., a mammoth apparatus 125 centimeters (49.2 inches) in spark length, constructed for the Vienna Technical High School. A similar apparatus has been constructed for the Potsdam Astrophysical Observatory, both being warranted to stand a potential of 1,000,000 volts.

The discharges of these induction coils comprise the fundamental and upper harmonic vibrations, the minimum and maximum wave lengths being inferred approximately from the length of wire in the primary and secondary circuits respectively. In connection with these giant induction coils the wave length of the fundamental vibrations is about 300 kilometers (186 miles) and that of the highest upper harmonic about 100 meters (328 feet). Their construction is based upon the following voltages between a positive point and negative plate with different distances at the moment of the first spark passage:

Spark length (cms.)	1	2	5	10	20	30	40	50	60
Voltage	50	100	175	275	475	650	800	950	1100

Spark length (cms.)	70	80	90	100
Voltage	1250	1400	1550	1700

On account of the special winding method contiguous turns of a coil will readily stand a much higher voltage so that their efficiency owing to the much smaller self-induction is increased considerably, resulting in those wonderful remarkably sustained discharges which sometimes show the aspect of flames. In fact the discharges of these giant induction coils carry a considerable amount of electricity.

The Heavens in September 1911

The Comets in the Sky; Location of the Brightest Stars; the Planets

By Henry Norris Russell, Ph.D., Professor of Astronomy in Princeton University

HAD the Moon been in her first quarter, instead of her third, Kiess's comet, which was within twenty million miles of the Earth on August 16th, would have been fairly conspicuous to the naked eye. As it was, the moonlight drowned it out pretty thoroughly. By the beginning of September this comet's rapid motion carries it into 52 degrees south declination, making it quite invisible in our latitude. As it is rapidly receding from the Sun, and still faster from the Earth (owing to its retrograde orbital motion), it will doubtless soon disappear from the gaze even of southern observers.

Brooks's comet—discovered at Geneva, N. Y., on July 26th by a veteran observer of such bodies—is approaching the Sun, and will not be in perihelion until October 27th. During the early part of September it will be fairly near the Earth (some fifty million miles away) and will be high in the northern sky, and above the horizon most of the night during which time it will be favorably located for observation and may even be visible to the naked eye.

Still a third comet is now in sight—Encke's, which is noteworthy for several reasons. Firstly, it has the shortest period of any known comet, returning to the Sun at intervals of slightly less than three and one-third years. Secondly, it varies in brightness at successive returns in a very singular manner, being sometimes easily visible in small telescopes (as it is reported at the present return), while at other times, though equally near the Earth and Sun and apparently as favorably placed, it is excessively faint, and can only be observed with powerful telescopes, as was the case at its last return in 1908.

Prof. Blacklund of Pulkowa, Russia, who has spent much time in the study of this comet, finds that it always appears faint when it lies in certain directions from the Earth and Sun, behaving as if it was a thin flat disk, almost vanishing when seen edgewise, but fairly conspicuous if not viewed too obliquely.

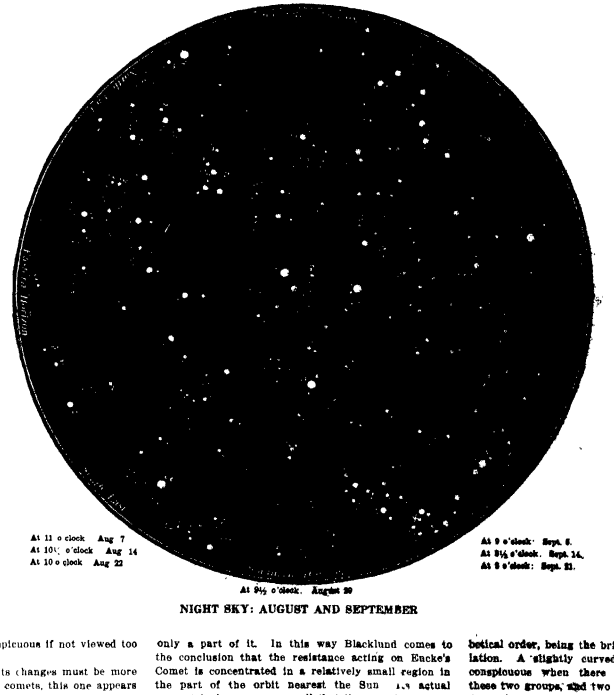
The actual explanation of its changes must be more complete for, like other faint comets, this one appears as a roundish mass of light. It would be possible to explain the facts by assuming that the comet was composed of a great number of separate particles all *strongly flattened parallel to the same plane*, but some less artificial explanation will doubtless in time be available. Third among the peculiarities of this comet, and most interesting of all from the theoretical standpoint, is the fact that its period of revolution is decreasing. This proves that some force, other than the attraction of the Sun, must act upon it, for otherwise, like the planets, it would always take exactly the same time to complete a circuit of its orbit. The attraction of the planets themselves would indeed give rise to slight differences in the duration of successive revolutions; but when the laborious calculations necessary to determine these "perturbations" have been carried out and checked so as to exclude any chance of error, it is found that there remains an unexplained shortening of the comet's period.

It is one of the apparent paradoxes of theoretical astronomy that the return of a comet *earlier* than the predicted time (provided this can be accurately determined) means that some force has been at work which has *retarded* the comet's motion. A full explanation cannot be given by elementary methods; but the principle involved is this. The retarding force decreases the rate of the comet's motion, as might be expected; but the Sun's attraction acting on the now slower moving comet draws it into an orbit smaller than before—so much smaller, indeed, that even at the slower speed it gets round it in less time than formerly.

By refined methods, taking into account the change in the form of the orbit, as well as the period, it is possible to discriminate between the influence of a minute retarding force acting steadily all along the comet's orbit, and a more powerful one exerted along only a part of it. In this way Blacklund comes to the conclusion that the resistance acting on Encke's Comet is concentrated in a relatively small region in the part of the orbit nearest the Sun. Its actual amount is, however, so small that the retardation cannot be detected by direct observation immediately after the comet leaves this region. It is only at the following return when the cumulative results during the whole following period become evident, that the extent to which the comet has been retarded can be calculated.

Still another curious circumstance must be mentioned. The amount of the retardation is not always the same. In the middle of the last century the period was shortened by about two and a half hours in each revolution; but since then the influence was twice abruptly diminished. Prof. Blacklund is inclined to explain this by supposing that the comet's motion is hindered by passing through a cloud of meteorities—or something of that sort—which is not of the same density at the successive times when the comet strikes it.

Enough has been said to show what an interesting body this little comet is to the astronomer. Accurate observations are now secured for as long an interval as possible at each return, and great mathematical skill, and enormous labor in computation, expended in the calculation of its motion; but it may still be long before the nature, and especially the variations, of the strange resistance to which its motion is subjected are fully comprehended.



NIGHT SKY: AUGUST AND SEPTEMBER

The Heavens.

Turning now to our map of the evening skies, we find that the splendid Cygnus right overhead. To the west is Lyra, with the resplendent star Vega, and southward shines the less luminous Altair. A brilliant region of the Milky Way, below this, leads us to Sagittarius and Scorpio—the latter almost setting in the southwest. Ophiucus and Serpens are farther to the right; then Hercules, Corona and Boötes, in an almost vertical line below Lyra. The Great Bear is well down in the northwest, with the Dragon and the Little Bear above. The vacant region below the pole on the other side contains the modern constellation Camelopardus—made to fill a gap between the ancient ones. Farther to the right, in the Milky Way, is another fine series of star groups—Auriga, just rising, then Perseus, next Cassiopeia, with the less brilliant Cepheus between her and Cygnus.

The great square of Pegasus is well up in the east. Andromeda is on the left, and Aries below. A few stars of Cetus have risen to the south of east. About southeast is a bright star, which from its southern declination and isolation is at once recognizable as Fomalhaut, the only conspicuous member of the constellation of the Southern Fish. Above this is Aquarius and farther to the right Capricornus.

Though one of the fainter zodiacal constellations this last is a fairly definite group of stars, and can easily be made out on a clear night.

Its principal stars which bear the Greek letters Alpha and Beta, are close together in the northwestern part of the constellation, at the head of the Sea-Goat, as our initial shows. About 20 degrees to the eastward the monster's tail is marked by the stars Gamma and Delta Capricorni, the latter, though fourth in alphabetical order, being the brightest in the whole constellation. A slightly curved line of faint stars, only conspicuous when there is no moonlight, connects these two groups, and two similar lines run downward from them, forming a triangle whose third vertex is marked by two stars (in the Goat's fore paws) which, though not much fainter than those already mentioned bear the last letters of the Greek alphabet—Psi and Omega.

Alpha Capricorni is a fine naked-eye double star, with components 6¼ minutes of arc apart. Beta Capricorni is also a wide double, but as the components are very unequal in brightness and separated by but 3½ minutes of arc, the aid of a field-glass is needed to see them separately.

The Planets.

Mercury is evening star at the beginning of the month, but is too near the Sun to be seen. On the 9th he passes through conjunction, and thereafter is a morning star, reaching his greatest western elongation on the 23rd. About this time he rises at 4:30 A. M. and can easily be seen.

Venus is also in conjunction with the Sun on the 18th and changes from evening to morning star. She can only be well seen toward the end of the month.

(Continued on page 219.)

Abstracts from Current Periodicals

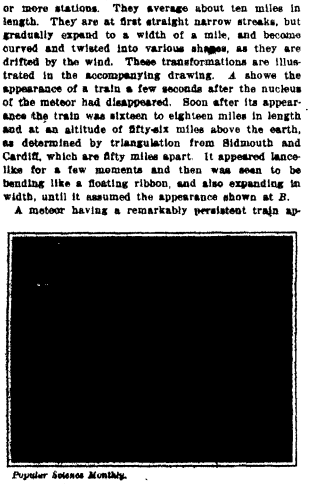
Phases of Science as Other Editors See Them

Meteor Trains

IN the *Popular Science Monthly*, August, 1911, Prof. C. C. Trowbridge, of Columbia University, presents a summary of the results thus far obtained in his study of meteor trains, which he has now carried on for a number of years, and which he has made the subject of several earlier contributions to the scientific journals. His activity in this field of research has been recognised by the National Academy of Sciences, which has made him a grant from the J Lawrence Smith Fund, to enable him to extend his work in this direction

Prof. Trowbridge applies the term "persistent train" to a meteor trail of long duration—from several minutes to an hour or more—as distinguished from a trail lasting, at most, a second or two, such as is ordinarily seen in the wake of a meteor. A large number of these persistent trains have now been observed and measured, and their altitudes have in many cases been determined by simultaneous observations at two or more stations. They average about ten miles in length. They are at first straight narrow streaks, but gradually expand to a width of a mile, and become curved and twisted into various shapes, as they are drifted by the wind. These transformations are illustrated in the accompanying drawing. *A* shows the appearance of a train a few seconds after the nucleus of the meteor had disappeared. Soon after its appearance the train was sixteen to eighteen miles in length and at an altitude of fifty-six miles above the earth, as determined by triangulation from Sidmouth and Cardiff, which are fifty miles apart. It appeared lance-like for a few moments and then was seen to be bending like a floating ribbon, and also expanding in width, until it assumed the appearance shown at *B*.

A meteor having a remarkably persistent train ap-



Popular Science Monthly.

Meteor train seen at Sidmouth and Cardiff, England.
Observed on November 14, 1898, at 1:08 A. M. Visible until 1:30 A.M.

peared over the south of England at 7.30 P. M., February 23nd, 1999. The train gradually increased in brilliancy, and twisted about, assuming grotesque shapes A part of it drifted to the northwest at a velocity of 80 miles an hour, and remained plainly visible until 9:30 or 10 o'clock, i. e., over two hours Another part drifted much faster; viz., at the rate of 300 miles an hour, according to the calculations of Mr Denning, the well-known English authority on meteors.

Prof. Trowbridge finds that the altitude above the earth's surface at which persistent meteor trains occur when seen at night is usually confined to definite limits between forty-five and sixty-five miles; though the path of the meteor may extend far above and below these limits. He terms this stratum of the atmosphere the *meteor train zone*. He assumes therefore, that in this zone there are conditions favorable to both the formation and the persistence of the luminosity of the trains, and he believes that the principal condition is the pressure of the atmosphere at that particular elevation.

He explains the train as a phenomenon of luminescence, similar to the afterglow following an electric discharge in a vacuum tube. When a body in very hot an immense number of negatively charged corpuscles or ions are given forth from it. Air containing free ions becomes a conductor of electricity, hence we have in a meteor rushing through the atmosphere a condition very like a long electrical discharge tube containing a gas at low pressure; the passage of the meteor-forming a column of highly ionized air thirty or forty miles in length.

Experiments with vacuum tubes containing air of about the same density that is supposed to occur at the altitudes in question, and from which the oxygen has been mostly extracted, give the same slowly-fading afterglow, following an electric discharge Thus, according to Prof. Trowbridge, it is not unlikely that the production of the light of a meteor train is connected directly with the highly ionized state of the air produced by the outpouring of electrons from the intensely heated meteor.

The rapid lateral expansion of the train is explained as due mainly to gas diffusion, and the rate of such diffusion depends upon the pressure and the temperature of the gas Accurate observations of the expansion of these trains should therefore aid in determining the pressure and temperature of the atmosphere at the altitude at which the train occurs Further the drift of the train furnishes a means of determining the direction and speed of the air currents at these great altitudes, which are far beyond the range of meteorological balloons

Whatever may be thought of Prof. Trowbridge's explanation of the physical nature of meteor trains, it is clear that their systematic observation should be considered a most important part of the general campaign of upper air research which is now engaging the earnest attention of meteorologists and astrophysicists

The Odor of the Rainbow

EVERYBODY has heard of the pot of gold buried at the end of the rainbow, but there is another old belief connected with this meteor that is not so familiar nowadays The attention of meteorologists was called to it, a few years ago, by Mr Richard Bentley, of the Royal Meteorological Society

It appears that over half a century ago a controversy took place in the English newspapers as to whether the rainbow emitted an odor A belief in such an emanation existed in antiquity, and has been echoed by several modern poets Thus it is mentioned in Pliny, Aristotle, and a Greek writer referred to by Coleridge, in his "Table Talk", in the "Peripatetic Philosophy" of Georgius de Rhodes; in Bacon's "Sylva"; in Browne's "Britanufa's Pastorals," and more lately in a poem by Robert Snow.

The origin of this curious belief is explained by Mr Bentley as follows Everyone is familiar with the increase of scent given off by plants and shrubs on a warm evening after the air has been newly washed by rain. This would naturally often coincide with the appearance of a rainbow

A New Miniature Projection Apparatus Suitable for Legal Photography

THE photographic work of experts in criminology is carried out usually with the aid of artificial light, at least when microscope objectives are used In these cases the surface to be illuminated is usually only an inch or two wide, but the illumination must be intense and very uniform The small projectors which are used by physicians for the examination of the eye and throat are ill suited for this purpose A writer in *Die Umschau* describes Geiger's new miniature projection apparatus, which may be used for photography as well as for other purposes As the accompanying illustration (Fig 1) shows, the apparatus consists essentially of a stand carrying a resistance box and the lamp with its housing and projecting lenses. The lamp is a self-regulating, or fixed point, electric arc, which consumes about 3 amperes of current, can be used on ordinary incandescent circuits and yields an exceedingly uniform light of about 300 candle power The two projecting lenses are mounted in a draw tube, by extending which more or less the diameter of the illuminated circle may be varied from an inch or two to twelve inches Even with the largest circle the illumination is sufficient for photographic purposes The size of the circle can also be limited by the use of diaphragms. The lamp can be moved vertically and horizontally on the stand, and the upper part of the stand carrying the lamp, can be inclined at any angle by means of the joint and screw shown just below the resistance box. The projector is also provided with a mirror which can be turned and inclined in any direction. By means of these various adjustments the dimensions and direction of the cone of light can be adapted to any purpose This flexibility of the apparatus will be found especially valuable when the working space is limited

This apparatus will be found very useful for scientific photography in many fields Here we will mention only its employment in photographing the so-called latent finger marks which are often used for the identification of criminals. Although these marks are called latent, they are not strictly invisible, but only difficultly visible, that is to say, a special kind of illumination is required to make them sufficiently conspicuous to be photographed Various devices for producing such illumination are described in special treatises Among these methods that of Stockis is the most successful, but it requires a special projec-

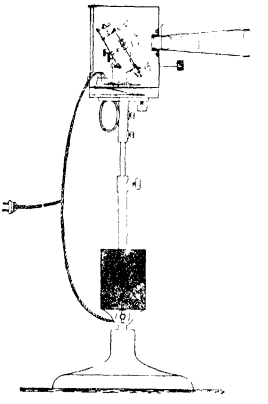


Fig. 1.

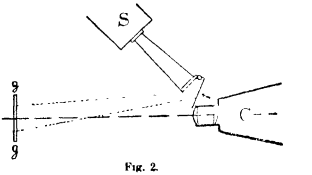


Fig. 2.
New miniature projection apparatus.

tion lantern, the mounting and adjustment of which are troublesome and tedious. The writer has obtained excellent photographs of latent finger prints on glass with Geiger's miniature apparatus arranged as shown in Fig 2 A camera *C* with an objective of long focus and a correspondingly long bellows is placed with its lens at the distance of twice its focal length from the piece of glass, *gg* bearing the finger marks The projector *S* is placed in an inclined position with its mirror almost in contact with the lens of the camera, so that the narrow conical pencil of light is nearly perpendicular to the surface of the glass and nearly coincident with the optical axis of the camera With this arrangement the papillary ridges of the

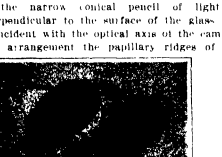
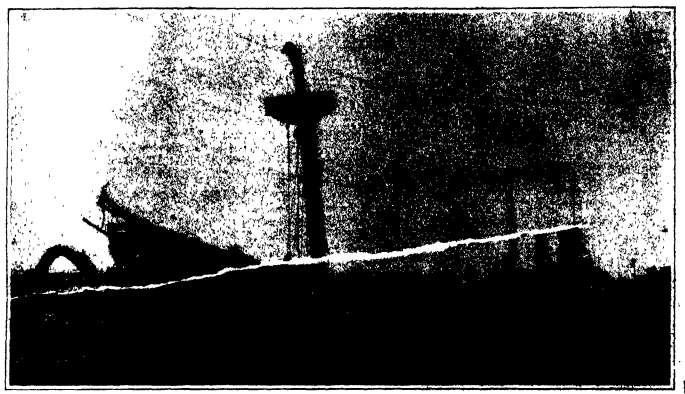


Fig. 3.
Photographs of finger prints obtained with the new miniature projection apparatus.

finger impression are intensely illuminated and appear on the positive photograph as white lines on a black ground Figure 3 shows a negative impression obtained directly in the camera on bromide paper by this method This negative shows the papillary lines black on white ground, and is hence directly comparable with the impression of the blackened finger on paper The great simplicity of this method should lead speedily to its general employment in criminal practice



This view was taken from off the port side. To the left is a boat crane. Abaft is a portion of a deck, which was blown up and back, exposing its under side. Abaft of this is the mainmast. The projecting material to the right is standing on the submerged poop decks. Beyond this is the "Kentucky" or "Kearsage."

THE "MAINE" AS SHE APPEARED AFTER THE DISASTER

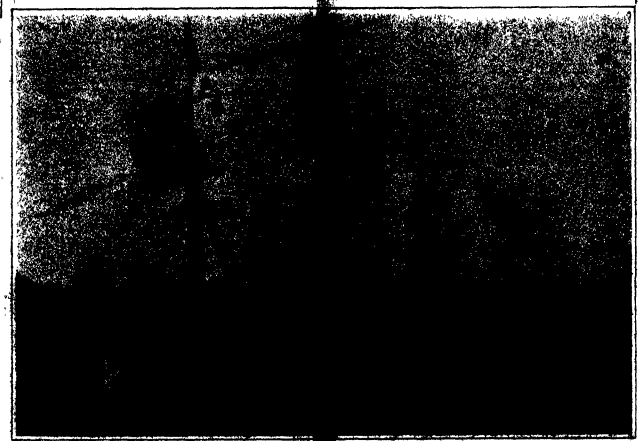
The Mystery of the "Maine"

Searching for the Cause of the Explosion

By Ludwig [illegible]ler, C. E.

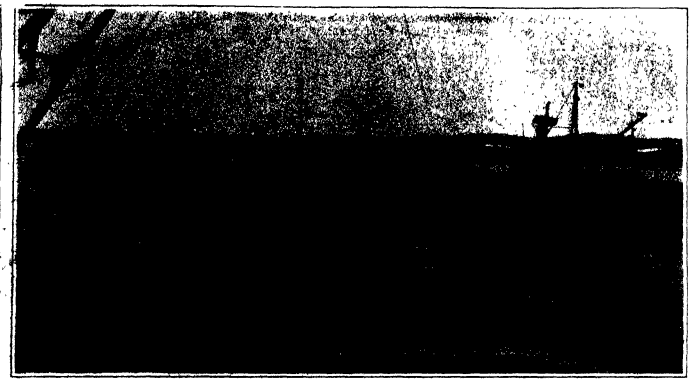
(Special Cor[illegible] at Havana)

["I was just closing a letter to my family when [illegible] the crash of the explosion. It was a bursting, rending and crashing sound or roar of immense [illegible] largely metallic in its character. It was succeeded by a metallic sound—probably of falling [illegible] a trembling and lurching motion of the vessel, then an impression of explosion, attended [illegible]es of the electric lights and intense darkness within the cabin. I knew immediately that the [illegible] had been blown up and that she was sinking. I hurried to the starboard cabin ports, [illegible] be necessary for me to make my exit in that way. Upon looking out I decided that I could [illegible] passage leading to the superstructure. I therefore took the latter route, feeling my way along the [illegible] bulkheads. The superstructure was filled with smoke, and it was dark. [illegible] the outer entrance I met Private Anthony, the orderly at the cabin door at the time. He ran [illegible], and, as I remember, apologized in some fashion, and reported to me that the ship had been blown [illegible] and was sinking."—So testified Capt. Sigsbee before the Naval Court of Inquiry into the Maine disaster. It is fitting that his dramatic story should be rewritten above these photographs showing the ship as, thirteen years later, she emerges from the waters of Havana Harbor.—Ed.]



The "Maine" in these days would be accounted an [illegible] ship. She was 318 feet long, of 6,682 tons displacement and 17.4 knots speed; carrying four 10-inch and six 8-[illegible] guns. She carried twelve inches of armor amidships.

THE "MAINE" AS SHE APPEARED [illegible] SHORTLY BEFORE HER DESTRUCTION



The caisson consists of twenty more or less independent steel cylinders about 50 feet in diameter, constructed around the wreck in elliptical form. As soon as all the cylinders were in place they were filled with earth dredged from the harbor.

A SECTION OF THE CAISSON

THE work of raising the wreck of the "Maine" from its thirteen years bed in Havana harbor has now progressed to such an extent that an intelligent idea may be had of the undertaking, the force of the explosion and permit of a consideration of the caisson or cofferdam being used in this work.

The wreck originally lay in about 35 feet of water, but the actions of the tides have raised the mud level over 5 feet, while the remains of the hull have settled into the mud about 35 feet. As the bottom of the wreck is not less than 60 feet below sea level, the caisson must finally sustain a pressure of 30 feet of water and 30 to 35 feet of mud before the hull of the vessel will be exposed either for examination or removal. The original idea of the engineers in charge of the work was to pump out the water and mud to this level, to uncover the entire wreck and determine, if possible, the cause of the explosion. The recent developments of the works have made it necessary to modify these plans, because the caisson has not developed the estimated strength.

The design of this caisson is somewhat of an innovation and must be considered more or less as an experiment, this being the first practical test on any large undertaking. It has not proved an entire success, and whether the defects that have developed can be remedied and this system perfected for future use is a matter for the engineers and the owners of the patents to determine, but from the results obtained in Havana the system does not seem quite feasible.

The caisson consists of twenty steel cylinders about 50 feet in diameter, constructed around the wreck in an elliptical form. Each cylinder must be considered more or less as an independent unit, as there is a foot of space between each of the cylinders, which space has been closed in on the outside line by a 15 foot segment of a cylinder, and on the inside with a wooden pile. The cylinders are built of 150 straight, steel, interlocking staves, about 75 feet long. The staves were driven one at a time around circular forms with insufficient false work, and care was not used in the driving to keep them plumb, the result being that the top of the circle was completed sooner than the bottom, which spread in many cases as much as 24 inches, and in a few others even more. The last stave driven, which completed the cylinder had to stand the strain of closing in the open space and drawing the bottom circle into line with the top. The interlocking jaws of the staves in some cases could not stand the strain and have splintered and cracked.

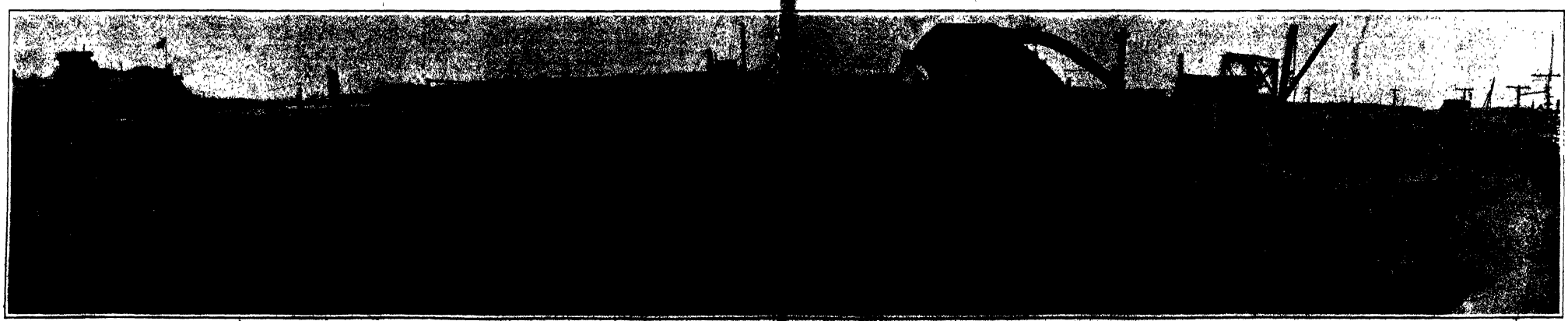
As soon as all the cylinders were in place they were filled with earth dredged from the harbor. The filling of the cylinders became necessary to make the joints between the staves watertight and to prevent the steel shell from crushing under the water pressure. The strength of the caisson is derived from the earth confined within the cylinders. What this strength will be is an open question. Where the caisson would fail if tested to the breaking point is hard to say. There must be at least 10 or 15 feet of slime and soft mud in the cylinders at the level of harbor bottom. The caisson is, therefore, weakest at this point where the water pressure is greatest, so failure might be expected at about 30 or 35 feet below sea level, or at the bottom of the harbor, provided a cylinder did not become detached and forced out of place.

When the caisson was completed and filled, the water was removed by degrees until a 15 foot level was reached before any signs of stress developed. At this point a thorough examination was made which showed that the various cylinders were moving, those of the side faster than those on the end, that the caisson, owing to the space between the cylinders, was not a complete unit, but composed of twenty separate parts each one acting independently. Besides this an examination below water by the divers showed that the staves of the cylinders were strained as mentioned above, and that they required immediate reinforcing. The water level was at once raised about 5 feet and maintained at the 10-foot level, while the caisson was being strengthened.

Seventy-five thousand tons of stone and rock have been dumped within the caisson and banked against the cylinders. This stone, of course, has sunk into the mud and raised it from about 30 feet to 22 feet below the sea level, so the wreck to-day is buried in about 40 feet of mud. The stone fill has strengthened the caisson, but has not stopped the movement of the cylinders. Many of them are 3 to 4 feet out of plumb, inclining toward the center. The original movement of the cylinders, before the stone fill, under the pressure of the 10 foot water level, was 1½ inches in 24 hours, while now with the rock reinforcement and with the water removed to the mud level, or about 22 feet below the sea level, the movement has been reduced to about ½ inch in 24 hours.

The stone reinforcement encroaches upon and banks against the bow and stern of the wreck, while in the wider parts of the caisson the wreck is still entirely free. As the 40 feet of mud is being removed from the line of the wreck, the weight of the stone will force the mud from beneath the stone, thereby causing it to settle deeper and deeper into the caisson. This will require additional stone reinforcing, as the reinforcing must be maintained around the top of the cylinders, to prevent them from toppling over. As the volume of the reinforcement is increased the embankment will encroach more and more upon the wreck.

To correct this evil at the bow and stern it has been found necessary to place a single line of steel sheet piling as close to the wreck as practical, to retain the mud and stone against the cylinders, and prevent any further encroachment upon the wreck. This sheet piling will have to be braced to the wreck itself to withstand the pressure from the caisson, while the mud is being removed.



Copyright 1911 by American Photo Company, Havana.

What is left of the bow, with portion of deck thrown up and back upon it with under side exposed.

This gap shows the region of the explosion. It represents the explosive energy of the 10-inch and [illegible] magazines; which blew out the sides, lifted the decks and folded them back upon the ship.

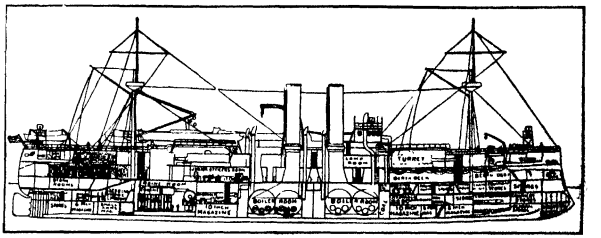
The central superstructure, with portion of deck folded back upon it. Note [illegible] armored side of ship with its square portholes.

The after turret with two 10-inch guns all intact.

Poop deck with portholes shutters still raised.

PANORAMIC VIEW SHOWING "MAINE" WRECK AND [illegible] COFFERDAM WALL WITH ROCK PILING AT ITS FOOT

A summary of the work, as it stands to-day, seems to show that the caisson is constructed of twenty separate units, which lack sufficient strength to withstand the pressure until filled, that the fill is of a nature not to withstand much pressure, that the cylinders were strained in placing, and that an additional row of sheet piling is required to keep the reinforcement free of the wreck. The caisson has proved not only inefficient, but very expensive. The first appropriation of half a million dollars was expended some time ago when the work was only half finished, and another half million will be required before the work is completed.



This longitudinal section of the "Maine" shows the location of the magazines.

While the caisson cannot be considered an engineering success it has permitted of the removal of the remains of our "hero dead." There are still many bodies unaccounted for and always will be, because the force of the explosion blew them free of the wreckage and into the harbor, but all the bodies confined within the wreck can and will be recovered. On August 12th the cruiser North Carolina arrived in New York harbor with the remains of Lieut. Merritt, one of the two officers who lost their lives. After all the remains have been recovered they will receive a fitting burial, with all the honors due brave and true men.

The cause of the explosion will never be learned if it was primarily of an external origin there will be no traces of it found to-day. The forward magazines have exploded and the hull is practically cut in two. The bridge and the conning tower with part of the decks and hull have been turned completely upside down and folded back upon the main deck amidship, while the bow is turned completely inside out and is a mass of unrecognizable junk. For a space of about 100 feet between the wreck of the bridge and the bow, soundings in the mud fail to show any trace of the hull. From midship to the stern the wreck is practically intact and can be raised without difficulty by building a bulkhead back of what was the bridge. The bow will have to be removed piece by piece by cutting the wreckage apart with acetyline torches. A plant for this work has been installed, with torches that cut through the steel wreckage like a knife through cheese. This work is already under way and part of the wreckage has been removed.

A wooden model of the "Maine" is in the engineer's office and piece by piece the model is being dismantled as the wreck itself is being cut apart. Several months must still pass before the wreck will be ready for its final burial in the deep waters of the sea, and the last visible sign of the wreck of the "Maine" will have been destroyed forever, excepting only such parts as the government may preserve for fitting memorial monuments to those who, without a moment's warning were sent into eternity by the explosion of the ship's magazine, the cause of which will forever remain unknown.

The Technical Museum of Vienna

THE Technical Museum in Vienna publishes a circular stating that in commemoration of the sixtieth anniversary of Emperor Francis Joseph's reign, Austrian manufacturers with the assistance of the State and the City of Vienna initiated this new museum. The foundation stone was laid on June 20th, 1909, and the building, which covers an area over 20,000 square yards, and which is situated opposite the palace of Schoenbrunn, is now nearing completion and will be a lasting monument of the monarch.

This Technical Museum is to demonstrate the development of industries and crafts in historical succession also to do justice to the technical achievements of the present day, and to promote progress in this line by periodical exhibitions. It is to be a public educational center, spreading the knowledge of the scientific foundations and the national economic aims of technical pursuits.

A considerable stock of objects has already been secured, as several large and valuable state collections, till now dispersed, are shortly to be brought together there. But many links in the chain of technical development are still missing. Therefore technical scientists, manufacturers and craftsmen of all countries are invited to co-operate in this great task and to assist the museum in procuring and selecting suitable objects. Everything pertaining to technical labor is acceptable, principally tools, machines, apparatus, models, materials, methods of working, finished articles as well as plans, designs, books, illustrations and manuscripts. The Austrian government has placed at the exhibition's disposal the halls of the Rotunde ("Prater") for the present storing and sifting of arriving donations. The names of donators will be perpetuated by inscription on the gifts and in a memorial book. Further particulars can be obtained from the office of the Technical Museum, Vienna, I Ebendorferstrasse 6.

Destruction of Banknotes

IT WILL come as a surprise to those whose chief difficulty in regard to banknotes is to be able to keep them to learn that there are yet others for whom the difficulty is how to get rid of them. Yet this is quite true in the case of those who have to destroy in bulk paper which has been used in representing money values. The difficulties thus encountered in destroying such paper are well illustrated by the experience of the German Imperial printers.

In this case the difficulties experienced are further increased by the necessity of coping with very large quantities of waste, for in addition to that arising from printing there is also that of stamp paper spoiled in the gumming as well as faulty water-marked paper.

The methods previously available were three—burning, boiling and pulping. In the first process it has been found even where a special furnace has been used, it has not infrequently happened that while the outer parts of the packets were destroyed some of the contents were not even singed. In the case of stamps or gummed paper the matter was still worse, for the packets baked together into solid blocks, the interiors of which were quite intact.

In the second process the paper for destruction is placed in iron boilers; lye is added and the contents then subjected to the prolonged action of steam. As a destructive process for small quantities this is most effectual, as is also that of pulping, a process in which the paper is cut up by revolving knives in water. In both of these cases there is, however, another difficulty, that of disposing of the product. It cannot be easily sold, it will not pay to transport and on hand the sodden stodgy mass quickly "goes bad."

The German imperial printers therefore decided to try a new way—grinding it up dry. To this end they installed a 40 horse-power Schlagkreuz mill, which by a process of hurling, crushing and tearing reduces the paper to an almost powderlike form in which it passes through a sieve into a collecting chamber beneath the mill ready for packing. This, however, was accompanied by a very objectionable feature, especially when dealing with gummed paper in the grinding—such a dust was created that though the workmen engaged wore protectors, it yet persistently filled and blocked their eyes and nostrils.

As the work of packing was on this account not only unhealthy, unwillingly performed and also uneconomical, efforts were made to find some mechanical means of doing it. Simple as this had seemed at the outset, later it appeared a problem almost insurmountable. Difficulty after difficulty arose. Among such may be mentioned that a spiral feeder having been devised it was found that the paper would some times form into balls as solid as blocks of wood, which defied the efforts of a 20 horse-power motor to move them. Nevertheless this difficulty was ultimately overcome.

The imperial printers, therefore, are now to be congratulated upon possessing a machine perfect in its kind. It takes the paper, grinds it up to any size desired and bags it. Finally though the paper in this form fetches but little on account of its consequent shortness of fiber, the mill is yet not only paying off the initial outlay, but is also saving some $250 a year in workmen's wages.

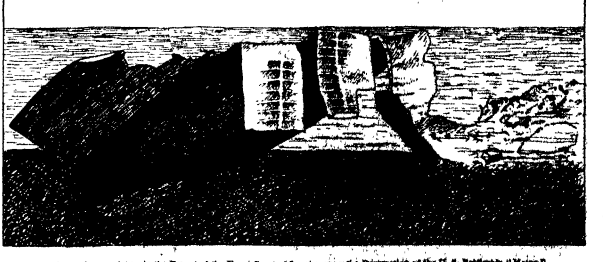
A National Bureau of Markets

ON August 14th a bill was introduced in the House of Representatives providing for the establishment of a new branch of the Department of Agriculture, to be known as the "Bureau of Markets." The duty of the proposed bureau, as defined by the bill, is to be "to make diligent investigation of the methods of marketing farm products, and especially with regard to finding out and recommending the fairest and most direct method by which farm products may reach the consumer from the producer, by accumulating and distributing information on the subject in question and on the subject of the best methods and best markets for selling."

While the language of the bill is somewhat confused, it is evident that a step of much economic significance is contemplated. It is the order of the day to throw light upon the mechanism of trade; and it is in harmony with the progressive ideas now being conspicuously fostered by the International Institute of Agriculture to bring scientific methods to bear upon the marketing of farm products. We believe that a work of far-reaching beneficence awaits the Bureau of Markets, and hope that Congress will see fit to give it being.

Tramways in Monte Video

ACCORDING to a Consular Report, the United Electric Tramway Company of Monte Video, which was formed and registered as a British company in 1904, owns and works 131 kilometers—82 miles—of lines in Monte Video, with 195 motor passenger cars and 68 trailers.



Redrawn from a picture in the Report of the Naval Court of Inquiry upon the Destruction of the U. S. Battleship "Maine."

Wreck of the "Maine" as disclosed by divers in 1898.

The Inventor's Department

Simple Patent Law; Patent Office News; Inventions New and Interesting

The Doutre Automatic Stabilizer

THE all too numerous accidents to aviators place the question of automatic stabilizers in the very forefront of interesting inventions. The ideal equilibrator would be one which would act in two directions, both laterally and longitudinally. Many attempts along this line have been made but hitherto have proved unsatisfactory. A very interesting new departure is a stabilizer invented by M. Doutre. This stabilizer has been installed upon a Farman biplane actuated by a 60-H.P. Renault motor. The well-known aviator, Didier, flew with the machine first alone and then with a passenger, and performed several flights which demonstrated the efficacy of the apparatus. In one trial the machine flew very successfully in a 36 mile wind.

The Doutre stabilizer acts upon the longitudinal equilibrium only. Under three conditions this equilibrium is affected, viz., by the slowing down of the motor, gusts of wind from the front, and gusts of wind from behind, which cause the machine either to rear or plunge to the ground.

To overcome the pitching, the aviator must turn the elevator in the direction of the pitching. But the pilot has not always the presence of mind nor even the time to carry out all these movements. The automatic stabilizer, it is claimed, claims to fulfill these functions spontaneously.

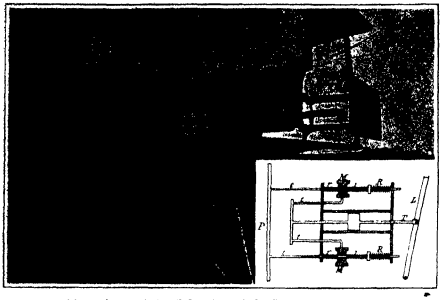
The stabilizer comprises two essential parts: First, a plane surface, moving a vertical plate in a sliding frame, and presenting its face to the wind, which causes it to recede more or less according to the intensity of the wind. This plate practically constitutes an anemometer which responds to the pressure of the relative wind. Secondly, there is a member which follows the displacements of the plates and transmits them through a system of joints to the horizontal rudder or elevator.

The movable resisting surface is a rectangular aluminium plate supported upon rods which slide in the frame of the machine, being maintained in a fixed position through the tension of a spring when the wind is normal. If the relative wind increases, the aluminium plate moves back in proportion to the resistance and returns to its former position as soon as the excess pressure disappears. Similarly, in case there is too little pressure, the aluminium plate moves forward under the action of the spring.

The sliding rods of the aluminium plate are connected with a central rod T which enters the cylinder of the compressed air auxiliary motor, controlling the piston of the same; it passes out of the other end of the cylinder, and actuates a lever L which controls the horizontal rudder of the aeroplane. It will, therefore, be understood that when the springs and lever joints are suitably adjusted, the movements of the aluminium plate under the action of the relative wind cause the admission of compressed air into the auxiliary motor, in proportion to the displacements of the piston rod, in one direction or the other; in this way, through the intermediary of the rear rod, the horizontal rudder or elevator is automatically controlled.

This apparatus, while effective by itself, is supplemented by another member which takes account of another factor bearing upon the equilibrium, namely, the weight and inertia of the masses. Thus, for instance, if the aeroplane should start to plunge forward and downward, the increasing relative wind would force the aluminium plate to its rearmost limiting position, and the elevator would be set in its normal position; the aeroplane would then continue in its course, heading for the ground. It would require a special act on the part of the pilot to restore the machine to its normal position. This, then, would not be completely automatic working. To overcome this defect the inventor provides a pair of small weights M mounted upon the sliding rods of the aluminium plate P and each maintained by two springs in such position that in normal flying the small weights follow the rods in all their movements. But as soon as the speed of the aeroplane changes, which will happen every time its course is deflected from the horizontal, these weights are either thrown forward or backward on account of the change of speed and their inertia. They thus overcome the tension of one or the other of the springs between which they are placed, and are displaced with reference to the rod upon which they rest. These weights are connected with the piston rod of the auxiliary motor which thus receives from them the atmospheric impulses impinging upon the aluminium plate.

In consequence of this not only is the auxiliary motor (through the intervention of the aluminium plate and the motion of the small masses together) placed under the influence of the relative wind but also under the influence of the longitudinal pitching of the aeroplane, through the motion of the small masses alone. Accordingly, the elevator obeys automatically one or the other of these external influences, and the longitudinal equilibrium is restored.



Near view and detail drawing of the Doutre stabilizer.



General view showing arrangement of the Doutre stabilizer on the aeroplane.



Redrawn from the *Illustrated London News* of June, 1850

An early transatlantic boat cruise.

An Early Transatlantic Boat Cruise

THE accompanying illustration, reproduced from an old volume of the *Illustrated London News* (June, 1850), presents a picture of quaint historic interest. The little boat, the "City of Ragusa," measured 20 feet in length and 6 feet in breadth of beam. Her registered burden was 1¾ tons. There was a small cabin, 3 feet wide and 4 feet 6 inches high. The boat, in its original form, belonged to the ship, "Breeze," which foundered in a storm in the Irish Channel and fourteen of the crew were saved by the boat. As shown in our illustration she is rigged as a yawl, arranged to set square sails on both masts, spreading altogether 70 yards of canvas in 8 or 9 sails. But she is also furnished with a two-bladed screw propeller which, so we read—can be worked either by hand or by a windmill as shown in the illustration. We leave it to the reader to make his own comments on this mechanism.

Two valiant men, Capt. Buckley and an Austrian Italian, named Pietro Di Costa, planned to cross the Atlantic in this tiny craft. They left Cork Harbor on the evening of Thursday, and were last sighted by a pilot cutter forty miles west of Cape Clear. Of their subsequent fate our source tells us nothing.

Electric Lamps for Miners

THE following copy of the conditions of entry for a competition to be conducted by the British government for advertising a safe and efficient type of electric lamp for miners has been furnished by the United States Bureau of Mines, also by the British Ambassador in Washington.

His Britannic Majesty's government announces that, in order to encourage the production of safe and efficient types of electric lamps for miners, a colliery proprietor has placed at their disposal the sum of £1,000 ($4,866.65) to be offered as a prize for the best lamp or lamps fulfilling the requirements specified below.

Mr. Charles Rhodes (a former president of the Institute of Mining Engineers) and Mr. Charles H. Merz (a member of the departmental committee on the use of electricity in mines) have consented to act as judges. The conditions of the competition are as follows:

1. The competition will be open to persons of any nationality.

2. It will be in the discretion of the judges to award the whole of the prize for the lamp which they consider to be the

best, or to divide the prize, or to make no award if no lamp appears to them to be of sufficient merit

4 Lamps must be addressed care of C. Rhodes, Esq., at the Home Office testing station, Rotherham, England, and must reach the testing station not later than December 31st, 1911. A spare globe should accompany each lamp

The requirements which should be fulfilled by any lamps submitted for competition are as follows

1 The lamp should be of sound mechanical construction, so as to withstand rough usage

2 The lamp should be of simple construction and easy to maintain in good order and repair

3 The lamp should be so constructed as to render impossible the ignition of inflammable gas either within or without the lamp

4 The lamp battery should be so constructed that any liquid which it may contain cannot be spilled when the lamp is in use, and means should be provided for dealing with any gas which may be generated by the battery

5 The materials used and the construction should be such that metals and other parts will not be liable to deterioration by corrosion as a result of the action of the "electrolyte," etc., used in the battery

6 The lamp should be effectively locked so that it cannot be opened without detection

7 The lamp should be capable of giving an amount of light not less than 2 candlepower continuously for a period of not less than 10 hours

8 The light should be well distributed outside the lamp. A movable reflector to concentrate or to shield the light may be provided

In addition to the above requirements, regard will be paid to (a) the first cost of the lamp, (b) the cost of maintenance, (c) convenience in handling, and (d) the weight of the lamp when charged and ready for use.

Trade-mark Rules Amended

ACTING Secretary of the Interior Samuel Adams recently approved the recommendation of the Commissioner of Patents that certain amendments to the Trade-mark Rules be adopted to take effect November 1st, 1911

The amendments are as follows

To be inserted immediately following Rule 45:

45a If an applicant fail to prosecute his application within one year prior to November 1st, 1911, or for one year after the date when the last official notice of any action by the office was mailed to him, the application will be held to be abandoned as set forth in Rule 57a.

45b Whenever action upon an application is suspended upon request of an applicant and whenever an applicant has been called upon to put his application in condition for interference the period of one year running against such application shall be considered as beginning at the date of the last official action preceding such suspension.

45c Acknowledgment of the filing of an application is an official action. Suspensions will only be granted for good and sufficient cause and for a reasonable time specified

45d Only one suspension must be approved by the Examiner of Trade-marks. Any further suspension must be approved by the Commissioner.

The first paragraph of Rule 56 is cancelled. The paragraph is as follows

56 From an adverse decision of the examiner in charge of trade-marks upon an applicant's right to register a trade-mark, or to renew the registration of a trade-mark, or from a decision of the examiner in charge of interferences, an appeal may be taken to the Commissioner in person upon payment of the fee required by law.

For the above there is substituted the following:

56 Every applicant whose mark has been twice refused registration by the Examiner of Trade-marks for the same reasons upon grounds involving the merits of the application may appeal to the Commissioner in person upon payment of the fee required by law. Such refusals may be considered by the Examiner of Trade-marks as final.

There must have been two refusals to register the mark as originally filed, or, if amended in matter of substance, the amended mark, and, except in cases of division, all preliminary and intermediate questions relating to matters not affecting the merits of the application must have been settled before the case can be appealed to the Commissioner.

The remaining paragraph of Rule 56 stands unchanged.

Following Rule 57, which relates to the taking of appeals in trade-mark cases to the Court of Appeals of the District of Columbia, there is inserted the following:

57a An abandoned trade mark application is one which has not been prosecuted within one year prior to November 1st 1911, or completed and prepared for examination within one year after the filing of the petition, or which the applicant has failed to prosecute within one year after any action therein of which notice has been duly given, or which the applicant has expressly abandoned by filing in the office a written declaration of abandonment, signed by himself and assignee, if any, identifying his application by serial number and date of filing

57b Prosecution of an application to save it from abandonment must include such proper action as the condition of the case may require The admission of an amendment not responsive to the last official action, or refusal to admit the same, and any proceedings relative thereto, shall not operate to save the application from abandonment

57c Before an application abandoned by failure to complete or prosecute can be revived as a pending application it must be shown to the satisfaction of the Commissioner that the delay in the prosecution of the same was unavoidable

57d When a new application is filed in place of an abandoned or rejected application a new petition, statement declaration, drawing and fee will be required

The foregoing amendments to the rules of the Patent Office relating to the registration of trade-marks, for the most part, are a paraphrase of similar rules that have long been adopted and used in connection with the prosecution of applications for patents This 47a corresponds with Rule 77 of the Rules of Practice, 56 corresponds with Rules 133-134, 57a corresponds with Rule 171, 57b with Rule 172, 57c with Rule 172, and 57d with Rule 173, etc.

At the present time the practice in the Division of Trade-marks is and has been not to consider an application abandoned by reason of the failure of an applicant to prosecute it within a specified time There is every reason why this practice should not continue Under the present practice, the first application filed under the Act of February 20th, 1905, which was acted upon soon after, must be taken up for action whenever the applicant desires, even if no action has been taken by applicant in the intervening time As the result of this procedure and the accumulation of a large number of cases, the Trade-mark Division is seriously handicapped in the prosecution of its necessary business It is estimated that there are now on file about sixteen thousand cases not "awaiting action" in the Office, and that three-fourths of these cases filed prior to January 1st, 1909, have not been acted upon within one year

Under the rules as amended to take effect November 1st, 1911, it is believed that the present difficulties involved in making an issue search would be materially lessened This search is made once a week by each of the seven assistant examiners and necessitates examining every one of the sixteen thousand drawings This has become a severe burden and was rapidly becoming more so It is estimated that at the end of ten years there will probably be twenty thousand more drawings which, added to those that are already filed, would make thirty-six thousand drawings. To search these once a week is an appalling task When it is also considered that the search of the examiners is increasing in length each year, due to the increase in the number of registrations granted, it is easy to see that the system in vogue could not indefinitely continue It was desired, therefore, to confine, so far as possible, the energies of the examiners to the search proper rather than expending them uselessly in searching each week a large number of practically dead applications. This saving in time and labor on the part of the examiners will greatly facilitate better and more expeditious examinations.

The rules as amended seek to accomplish only, in connection with trade-mark applications what is now accomplished in connection with applications for patents by similar rules. The language of the rules follow somewhat closely the corresponding rules, so far as the language employed in connection with applications for patents is deemed applicable to applications for the registration of trade-marks. Moreover these rules are regarded as being in every way consistent with the statutes.

Notes for Inventors

Losing One's Way in the Air.—An army aviator, Capt Paul Beck, flying from College Park, Md., recently lost his way for an hour or so in the clouds and landed finally over in Montgomery County, miles out of his course. It appears that the ordinary mariner's compass is not satisfactory for use in the air, since the aviator cannot determine, after he loses sight of the earth, the extent to which he may have drifted laterally from his course The incident has stimulated renewed interest in the subject and Capt. Chambers, who has charge of naval aeronautics, is continuing his efforts to devise some means whereby aeronauts may be able to determine the course with reasonable accuracy.

A Medal for a Printing Office Employee.—On behalf of the Public Printer, Vice-President Sherman has presented the assistant foreman of the foundry section of the Government printing office at Washington, D. C., with a gold medal for an invention, hygiene in its nature, and operating to reduce the danger to health, resulting from graphite dust in electrotyping and printing.

A Domestic Cream Separator.—A domestic cream separator embodied in a milk bottle of the form commonly used by dairymen in delivering milk to customers is shown in a patent, No. 999,747, to Ada B Brown of Seattle, Wash It has an L-shaped tube journaled in an opening in its side at about the base of the neck and having an upturned wing in the bottle which, by turning the horizontal journaled wing, can be set to different heights to take cream from different levels and discharge it through the horizontal wing to the outside of the bottle.

A Fireproof Coil for Electrical Apparatus.—Seeking to provide a fireproof coil for electrical apparatus, Charles E. Skinner of Wilkinsburg, Pa., assignor to the Westinghouse Electric & Manufacturing Company, has patented No. 999,893, a coil which has a plurality of turns of conducting material with a strip or layer of metal foil interposed between the adjacent turns, the foil being first treated to provide an insulating film on its surface.

A Moving Spiral Staircase.—The Otis Elevator Company has obtained a patent, No. 999,885, for an elevator which has a conveyer transporting between different levels in which the direction of movement is clockwise and contra-clockwise. The elevator is in the form of a moving stairway, having ascending and descending series of steps which travel in spiral paths in opposite directions about a common center of curvature The inventor is Charles Leeberge of New York city.

Printing by Sound.—A method of printing by sound is the subject of a patent, No 999,975, to Arthur C. Ferguson of Brooklyn, assignor of eleven-sixteenths to Lyman C. Smith of Syracuse, N. Y. By the method, the sound waves are recorded by utilizing a succession of said waves to initiate the operation of mechanism actuated by a separate source of energy for printing a legible character corresponding to certain tone characteristics of said waves. In other words, the character printing mechanism is actuated by a separate source of energy and the waves are utilized to control such source of energy.

LEGAL NOTICES

PATENTS

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RECENTLY PATENTED INVENTIONS

These columns are open to all patentees The notices are inserted by special arrangement with the inventors. Terms on application to the Advertising Department of the SCIENTIFIC AMERICAN.

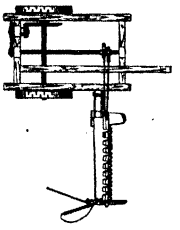
Electrical Devices.

HIGH TENSION STRAIN INSULATOR.—L. Steinberger, New York, N. Y. This insulator is for general use where currents of high potential are employed, it being especially well adapted for use in wireless telegraphy and telephony. Mr Steinberger's special purpose is to provide a number of novel constructional features in order to improve the general efficiency of the insulator, and to enable him to make it of an insulating material formed under pressure or molded, or of porcelain, glass or such like material, and to employ tension members of a rigid or of a flexible character, as may be desired.

ELECTROMAGNETIC VIBRATOR FOR LOCAL APPLICATION TO THE PERSON.—A. Rosenberg, London, England. This vibrator is for use for the production and local application to the person, of continuous, rapid, and intense mechanical vibrations of oscillations suited to the treatment of various maladies which are curable of being temporarily or permanently ameliorated by the application thereto of the mechanical vibratory massage and to the combination with the instrument of means whereby a pulsatory electric current may be passed through the body from the point of application thereto of the vibratory treatment and simultaneously with the latter

Of Interest to Farmers.

CUTTING MACHINE.—Clarence Shaw, Johnstonville P. O., Lassen Co., Cal. This invention relates more particularly to cutters and rearthers for cutting grain and the like, and the object is to provide a device for cutting down grain and the like when it is desired to harvest the same For the purpose mentioned, use is made of a vehicle chassis provided with a cutter frame having a plurality of cutter bars thereon and connected with



CUTTING MACHINE

eccentric means, secured to suitable driving means in engagement with the wheels of the vehicle, to operate the cutter bars, and a weather secured to one end of the frame for dividing the cut and uncut grain and for substantially preventing the latter passing through the cutter bars after the same has been cut down The engraving shows a plan view of the machine

Of General Interest.

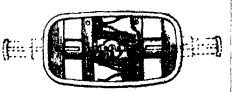
JOINT FOR ARBORS.—H. S. Davis and J. C. Hayden, P. O. Box 342, Port Hope, Ontario, Canada In this case the purpose is to provide joints for arbor sections used in castings which will permit the sections to be readily separated by striking one of the ends of the arbor and breaking the wedge member holding the sections together Another object is to so construct the sections that they will be held together by a wedge member of combustible or fusible material, the rigidity of which is lost by the heat and by contact with the metal, thereby permitting the sections to fall apart as the casting is removed from the same.

BASE FOR CARDBOARD FIGURES.—H. G. Fearns, Philadelphia, Pa This invention refers particularly to miniature cardboard figures in the shape of dolls and the like, and the object is to provide a form of base for holding the cardboard figure Wood and metal are ordinarily employed for the purpose, aside from the expense, they leave much to be desired in applying the base to the figure and the secure holding of it in place, while the present base permits of employing a figure made from much lighter cardboard than is really practical with a wooden or metallic base.

Hardware and Tools.

COMBINED LOCK AND RETAINING DEVICE.—M. Jasenska, New York, N. Y. In this instance use is made of a bolt slidably mounted in the inner end of a receptacle to engage the casing thereof, actuating means mounted on the outer end of the receptacle, and a flexible connection disposed between the actuating means and the bolt so that the bolt will automatically engage the casing when the actuating means are operated and the bolt being normally positioned so that the receptacle cannot be entirely withdrawn from the casing.

LOCK.—Raffaele Fiola, 2 East 120th Street, New York, N. Y. A rear elevation of the lock is reproduced in the illustration which shows the bolts projected in dotted outline. The lock serves the purposes of the ordinary padlock, which, when in position prevents the staples or eye-bolts from being cut or filed, and which renders difficult other unauthorized

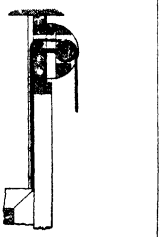


LOCK

methods of opening the lock The bolt proper is operated by key-controllable mechanism of the pin tumbler type, which permits of a large number of variations in the key-controllable mechanism, and which may bring the casing of difficult shapes adapted for use with different kinds of doors or other closures.

Household Utilities.

SASH CORD GUIDE.—James P. O'Reilly, Hayden, Ariz. By the old construction and method of attachment, it is necessary to bore two holes one-eighth of an inch deep in the window jamb and then three more completely through the frame and finally to chisel out the triple bore to form a mortise adapted to receive the pulley frame In carrying out



SASH CORD GUIDE

the present invention it is required to bore only one hole and through the jamb, and then to insert therein a holder cylinder having interiorly, a small sash-cord pulley, and on the projecting end of the cylinder the frame containing the usual sash cord pulley is hung detachably the engagement being effected by a sliding joint The engraving is a vertical section of window frame or joint, with the attachment applied thereto

Machines and Mechanical Devices.

AUTOMATIC PHOTOGRAPHIC PRINTING MACHINE.—Giomo W. Ferguson, 314 Boonville Street, Springfield Mo The present device is an improvement over that disclosed in the prior patent No. 957,668 granted to Mr Ferguson The aim of the present invention is to provide devices for timing the exposure Those include novel means for switching on and off the circuits, and for controlling the same A further object is to provide a remov-



AUTOMATIC PHOTOGRAPHIC PRINTING MACHINE.

able lamp holder which may be quickly removed from the device so as to replace the lamps in case they become broken, and as quickly replaced, the replacement of the holder serving to again bring the lamps into circuit The illustration herewith represents the main box, the end being removed for the sake of clearness.

NOTE.—Copies of any of these patents will be furnished by the SCIENTIFIC AMERICAN for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.



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1611 and 1612—The Sources of Industrial Alcohol, that is the Farm Products from which alcohol is distilled, are enumerated by Dr. H. W. Wiley, and their relative alcohol content compared

1627 and 1628—The Distillation and Rectification of Alcohol is the title of a splendid article by the late Max Maercker the greatest authority on Alcohol Diagrams of the various types of stills in common use are used as illustrations

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By N. MONROE HOPKINS.—This "built-up" laboratory balance will weigh up to one pound and will turn with a quarter of a postage stamp. The balance can be made by any mechanic skilled in the use of tools, and it will work as well as a $125 balance. The article is accompanied by detailed working drawings showing various stages of the work. This article is contained in Scientific American Supplement, No. 1184. Price 10 cents. For sale by Munn & Co., Inc., 361 Broadway, New York City, or any bookseller or newsdealer.

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Notes and Queries.

Kindly keep your queries on separate sheets of paper when corresponding about such matters as patents, subscriptions, books, etc. This will greatly facilitate answering your questions, as in many cases they have to be referred to experts. The full name and address should be given on every sheet. No attention will be paid to unsigned queries. Full replies to correspondents are printed from time to time and will be mailed on request.

(12526) C. H. K. asks: 1. It is held I think by most astronomers that the pole of the heavens traces a complete circle around the pole of the ecliptic in about 25,000 years, and has for its center the pole of the ecliptic. There is also a decrease in the obliquity of the ecliptic of about 45 seconds in a century. Now, how can the pole of the ecliptic be the center of the circle traced by the pole of the heavens when the distance is gradually decreasing between them? As the obliquity of the ecliptic is equal to the radius of this circle, we would then have a circle in which the radius is constantly changing, which I think is quite impossible. A. In an exact sense it is true that a curve with a radius which varies cannot be a circle, as you say; but since the obliquity of the ecliptic changes only a few seconds in 100 years, while the precession of the equinoxes is about 50¼ seconds in one year, the change in the radius of the precessional effect on the pole of the heavens is at most infinitesimal in one year. We think astronomers are quite warranted in speaking of the motion of the pole of the heavens as in a circle around the pole of the ecliptic, although some use the latter term "cycle," since the variation in the obliquity of the ecliptic is also in a cycle. At some remote time it will return to its present value. 2. What was the obliquity of the ecliptic in 1900? A. The obliquity of the ecliptic for 1900 was 23 deg. 27 min. 8.02 sec., as given in Todd's "New Astronomy," page 150, a book which we send for $1.50. 3. Is there any evidence to show that an individual organism has the power to modify itself physically to meet a change in environment or meet conditions to which it is not adapted? A. Probably an individual organism has not the power to modify itself radically to meet a sudden change of environment to which it is not adapted. 4. Is there anything to show that evolution takes place apart from natural selection? A. All the causes of change in species and individuals and not natural selection alone are involved in the proof of the theory of evolution. The literature of the subject is very extensive, beginning from Darwin's "Origin of Species," which we will send for $2. Many articles have from time to time been printed in our SUPPLEMENT.

(12527) R. A. S. asks: What is the astronomical name of the star which is known as the star of Bethlehem, which guided the shepherds and the wise men at the birth of Jesus Christ and can be seen in Palestine every year on and about December 25th? A. There is no star known to astronomers as the "Star of Bethlehem." 2. Would a postage stamp vending machine pay? In the large post offices a great deal of time and bother is taken in handling and selling special stamps. Would it not pay the Government to have machines in the large cities eliminating this trouble? A. There are several kinds of stamp vending machines in the large cities, both in America and in Europe. We do not know whether they are profitable or not. 3. What are the advantages of raising the "Maine"? Does it not cost more to raise it than the old hull is worth? A. The raising of the Maine clears a dangerous obstruction from a friendly harbor, enables us to give burial to the bodies of the men who died in the service of their country on this ship, and may clear up the uncertainty as to the cause of the explosion. Any one of these reasons is quite sufficient to justify the expense of the work. The old hull is worthless. It was long ago corroded by salt water, and was so twisted by the explosion that it could not be rebuilt to be of any value. Its only pecuniary value would be as old metal.

(12528) J. C. O. says: Regarding a differential gear on an automobile using say 10 horse-power. A. claims that if standing in a straight line the same amount of power is applied to both drive wheels, but that in turning a corner the power is shifted to the outside drive wheel and that if it were required practically the full (40) horse-power would be exerted on this outside driver. B. claims that in making the turn as much power is exerted on the inside driver as on the outside. In other words (if it were required) 20 horse-power on each driver. Which is correct? A. The driving gear of automobiles is designed to exert an equal turning movement on each driven wheel at all times. If an automobile could be steered so sharply to one side that one rear wheel stood still while the other turned around it in a circle (this might be done by a three-wheeled car) the stationary wheel would be pulled on by the gearing just as hard as the moving wheel; but as it could not turn no "work" would be done upon it, and the "work" of turning the car would be done by the moving wheel entirely. Do not confound *force* with *work*; the latter implies motion in the direction of the force which produces it.

NEW BOOKS, ETC.

THE PRINCIPLES OF INDUSTRIAL MANAGEMENT. By John C. Duncan. New York; Appleton & Co., 1911. 338 pp. Price, $2.

The book is divided into three main sections devoted respectively to "The Economic Environment," "The Equipment of the Plant," and "Organization and Management." It deals on broad lines, and yet in considerable detail, with the various factors upon which the economic success of an industrial enterprise depends. The theory of industrial location, the different forms of "business concentration and integration," and the *rationale* of business specialization are some of the topics discussed in the first part of the book. The first three chapters of the second part follow a classification of the various industries as "synthetical," "analytical" and "assembling industries," a number of specific examples of each kind being given. As regards questions relating to plant equipment. Other topics taken up in this portion of the book are "Fire Precaution", "The Building," especially in its relation to the workers and "The Power Problem." The last section discusses the different types of organizations, the labor force and the methods of keeping records of work, equipment, raw materials, etc., and controlling expenditures in wages and purchases respectively. The subject with which Prof. Duncan deals is one of the greatest practical interest and will appeal to all who take any share in industrial work.

MOEURS DES INSECTES. By J. H. Fabre. Paris: Delagrave, 1910. 271 pp.; 12mo.

This volume is a selection of essays from the author's "Souvenirs Entomologiques." These delightfully written essays in a popular vein have been widely circulated in France, as they justly deserve to be. They are literature of a most artistic kind, even though the subject is scientific.

SKETCH OF A COURSE OF CHEMICAL PHILOSOPHY. By S. Cannizzaro (1858). Alembic Club Reprints. University of Chicago Press, 1911. Price, 43 cents.

To the person who has once acquired the habit of viewing the main facts of modern science in close relation to their historic development, this standpoint acquires a special value which is more easily appreciated than explained. The growth of a science is itself a natural phenomenon of peculiar interest, and probably no one ever has made himself the master of any branch of science, who did not in the process acquire a fairly complete knowledge of the genesis and history of that science. The consultation of first hand sources as compared with the mere reading of textbook reproductions, has, upon the student, an influence some what akin to that which personal contact with the great workers in science exerts. These things can be felt, but are difficult to analyze and explain. That they have been keenly felt by some of the foremost men of science is the cause of the publication of such series of reprints of classical scientific papers as the Alembic Club Reprints in English, and Ostwald's Klassiker in German. To express commendation of such publications, in view of the great authorities who have not merely passively approved of them, but actively aided in their realization, would seem almost presumptuous, and is at any rate quite unnecessary. That the present little volume should form one of the series is a fitting starting point. In it Cannizzaro presents with the masterly method of a great teacher the fundamental facts which form the basis of Avogadro's hypothesis. It must be remembered that while this hypothesis had been put forward as early as 1811, more than forty years prior to the date of Cannizzaro's work here republished, very little notice had been taken of Avogadro's law, and its immense importance to chemistry was not realized. Without this hypothesis a rational system of atomic weights was impossible, chemical notation was in a bewildering state, and the proper interpretation of all those relations between elements, which are closely connected with their atomic weights, was rendered extremely difficult. It is hardly possible to overestimate the importance to the chemical world of Cannizzaro's influence in bringing about the general appreciation of Avogadro's hypothesis. The little book should be in the library of every teacher of chemistry.

THE PRINCIPLES OF MACHINE WORK. By Robert H. Smith. Boston: Industrial Education Book Company. 8vo.; 388 pp., 434 illustrations. Price, $3.

This textbook, which takes up the subject where "The Elements of Machine Work" dropped it, admits technical students into the secrets of engine and speed lathes, drilling and grinding machines, steel cutting, measuring, turning, fitting, threading, chucking, reaming, jigs, fixtures, and cylindrical grinding. Mechanisms, tools and their approved methods of use are shown in original perspective and mechanical drawings while condensed tables briefly describe them. The common machining operations, with typical problems, are given in schedules which name the material, processes, machines, speeds, feeds, jigs, fixtures, and tools. As a guide to the young student of shop apprentice the work should prove invaluable.



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The Heavens in September

(Concluded from page 208.)

when she rises a little earlier than Mercury. On the 24th the two planets are in conjunction; that is they are as close to one another as their apparent paths allow; but in this case their distance is unusually large—over nine degrees—Mercury being the farthest north.

Mars is in Taurus, between the Pleiades and Aldebaran in the middle of the month, and rises about 9:30 P. M. Though only about half as bright as he will be at opposition in November he is already a very conspicuous object.

Jupiter is evening star in Virgo, and sets a little after 9 P. M. on the 15th Saturn is in Aries, approaching opposition and rises at about 8:45 P. M. on the same date.

Uranus is in Sagittarius and comes to the meridian at 9:10 P. M on the 1st and 7:16 on the 30th. Neptune is morning star in Gemini, rising about 1 A M in the middle of the month. The Moon is full at 11 A. M. on the 6th, in the last quarter at 1 P. M. on the 15th, new at 9 A. M. on the 22d, and in her first quarter at 6 A. M. on the 30th. She is nearest us on the 17th, and farthest away on the 1st, and again on the 29th.

She is in conjunction with Uranus on the 4th, Saturn on the 13th, Mars on the 14th, Neptune on the 17th, Mercury and Venus on the morning of the 21st, and Jupiter on the night of the 25th.

At 11 A M on September 23rd the sun crosses the celestial equator, entering the sign of Libra, and, in the old phrase, still used in almanacs, 'autumn commences"

How Animals are Taught Their Tricks

THE training of animals, to teach them to perform all sorts of entertaining tricks, is a task that requires perhaps a special talent on the part of the trainer, but above all demands patience and a thoroughly methodical procedure. Let us begin with the dog, and see how he is taught his tricks. We commence with the simplest, and gradually work up to the most complex and apparently impossible feats

The first thing every dog must learn is his name Select a short, sharp-sounding name, and stick to it. Never call him anything else If you have several dogs, the name is taught on the same principle Divide their food, and then, placing a piece on the ground, call each in turn by his name, and give him the food when he comes for it. Send the others back if they come forward out of their turn. By and by they will learn that a certain name is always associated with a certain dog. Ramble among the dogs, and call out one of their names every now and then. If the right dog comes to you, reward him with a piece of cracker Pay no attention to the other dogs. They will learn very soon; and the first great lesson—dependence and obedience—will have been learned

Having taught a dog to fetch and carry —which he will easily learn—the next thing is to teach him to go and get any object called for Place a glove on the floor; then say to the dog, "Fetch the glove," putting the accent on the last word. Then, when he has done this several times, place a shoe on the floor; and teach him to fetch this in a similar manner Now place both objects on the ground, and teach him to fetch either one, as asked for—rewarding him when he brings you the right one, and rebuking him when he fetches the wrong, which you take from him and replace. He will soon learn to distinguish the articles, when a third may be substituted, and so on until a number are on the floor. You should then go into the next room, taking the dog with you, and send him in to fetch any article you mention. After a little time, he will bring you the right one every time.

Next, teach him differences in color. Place a red object on the floor, and a blue one beside it. Teach him to fetch you the article called for as you did before, being careful to reward him every time he brings you the right handkerchief. Then put down a green object, a purple, a yellow one, and so on; until finally the needed array of colors can be placed for selection.

Next, he should be taught the articles of furniture—table, chair, etc. He must go to each one as you call out its name Finally, combine some of the previous commands "Place the glove on the chair", "Get the handkerchief, and place it on the table," etc. At first this should be said very slowly, and only half the command repeated at once; but the halves of the sentence may be gradually blended together, until you can say it as you would to any individual; and the dog will obey your command.

To a certain extent, also, dogs may be taught the letters of the alphabet, the numbers of spots on cards, large dominoes, etc The method of training them is simply one of constant repetition Cards bearing the letter or number are placed in front of the dog, and the letter or number is called out aloud, and at the same time the dog is shown which one it is. After several trials, he will select this one and disregard the others, when it is called for This once learned, the next letter is taught in like manner, until a large number are recognized by the dog, and he is able to pick out any of them at will Plants are also to be selected in a similar manner, from a row placed on the table, and so forth

It must be admitted, however that most feats of this character, as performed in public, are the result of some trick, rather than any marvelously elaborate training on the part of the dog which would be necessary if these feats were genuine—granting them to be possible at all As a matter of fact, most of these apparently marvelous feats are based on a very few cues, given to the dog at the appropriate time, to which he has been taught to respond in a simple manner. A few examples will make this clear

Many of these feats are performed by means of a cue word, in just the same kind of way as "mind readers" entertain and puzzle their audience As soon as this word is given, it may be in the course of a sentence, the dog knows that he is to perform a certain action It is not necessary for him to understand the whole of the sentence; only one word in it As soon as that word is caught the action is performed Each action corresponds to a certain cue word. Again, there is the method of training by the use of the eyes. The dog watches his master's eyes, and when his master glances in any direction—at a card, for example—the dog can follow his glance, and pick out the card in turn Or the dog may be told to bark a certain number, in which case the dog watches his master's face closely, and simply barks until the eyes, or some movement, tell him to stop He does not have to know that he barks nine times. All he has to know is that he must go on barking until he is told to stop by his master's signal, and the trainer is the one who does all the counting

There are certain stage tricks which depend very largely upon the dog's memory, however—such as picking up a numbered card, and the like The cards are arranged in a row, and the trainer stands in front of the row in which the card rests. A string is attached to the dog's neck First the dog is trained to go to the row of cards nearest the trainer; then, if he is inclined to pick up one too near, a slight pull on the string is given, pulling the dog up to the required number The trainer stands at a certain distance from the table in these tricks, if close to the table, the dog knows it means card one; if farther away, card two, and if still further, card three By care in training, the dog can be taught to pick out any required card, without in any way knowing the number written upon it When the dog has been taught to pick up any card by means of this code, the trainer may appear to make it far more complicated by causing the dog to add, subtract, multiply, divide, etc. All that is necessary, of course, is that the performer himself should do the sum, mentally note the position of the card giving the answer, and indicate this card to the dog by means of some hidden code.

In the same way, horses can be made to stamp out any desired number, tell the date of a coin, etc., by simply going on pawing the ground until the trainer gives them the signal to stop by means of some secret sign, unnoticed by the audience.



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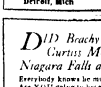


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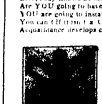
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As to the animals which perform in the circus, the elephant is among the most popular, and it seems wonderful that so unwieldy an animal can be made to perform any tricks at all. How set about training an animal of this kind? What is the first thing to be done? And how?

In compelling the elephant to perform, advantage is taken of the fact that the feet of the animal are peculiarly sensitive and he dreads any injury to them. Many of his tricks are based upon this principle Thus, he is made to place one foot upon a low pedestal; then the other foot is tapped gently, and he raises this and places it beside the other—to get it out of harm's way. The hind feet are treated similarly, in turn—the front feet being hit every time they are placed on the ground In this way all four feet are finally placed upon the tub The trick of inducing an elephant to partake of a meal is very simple Animals will naturally eat anything placed before them, and it is only necessary to open a bottle of "pop" once or twice, and present it by hand, when the animal may be trusted to find out for himself how to get at its contents In all such cases, the essence of the training consists in infinite patience, kindness, and constant repetition—showing the animal over and over again how a thing is done—in precisely the same way—and then forcing him to do it himself

Lions and tigers are always dangerous creatures to work with, and one can never be sure of them, even when trained "No wild animal," says Mr Bostock, "is ever tamed, only trained, and the best training in the world is nothing when once the animal feels inclined to give way to his natural savage instincts"

"In time," continues Mr Bostock, "the trained animal becomes so accustomed to performing that when he sees the paraphernalia of his performance he knows exactly what is expected of him, and does it naturally and readily The successful performance of all trained animals depends on this almost instinctive following of long-accustomed habit, together with the pleasure the exercise gives to animals habitually confined in small cages

"Leopards, panthers and jaguars are all trained in much the same manner Mme Morelli puts them through a course of training very similar to that given the lion They are taught to respect and look for the trainer, and have instilled into them as much awe as is ever bred in any animal—which is not saying a great deal Some animals train easily, others learn their lessons with great diffidence and some reluctance What one lion may learn in a week another may learn in a month; what one tiger may do in two lessons may take another one several months to imitate feebly"

Goats are very sure-footed animals, and learn to perform many tricks requiring that quality—such as standing on the end of a bamboo pole The Hindus teach goats to do this Hogs may be taught a number of clever tricks, and are far more intelligent than is generally imagined Monkeys are known to be capable of being trained to a remarkable degree, the feats of "Peter" and "Consul" being well known to the American public They are good imitators, and excessively curious, and it is this faculty, and their ingenuity in satisfying this curiosity, which has amused many an audience; and has given rise to the popular notion that monkeys are far more intelligent than they really are As a matter of fact, although a few of them are highly trained and intelligent, this is not the general rule

A few birds may be trained to perform simple tricks, but not many "Fortune tellers" employ tame birds to help them in their trade A number of small paper envelopes are seen, in a row, one of which contains your "fortune" In the shape of a slip of paper, telling you certain platitudes about yourself. The bird picks this envelope out with his bill, from among others How is it he selects this particular one? Some of the envelopes have seeds glued to their back covers, and the bird naturally picks out one which has the seed thus attached—passing over the others to get to it. In most birds, when first caught, a portion of the inner plume of the pen-feathers is cut, so that the bird cannot escape; and then the nostrils of the bird are touched with bergamot or other odorous oil, by which it is for the time so stupefied that it perches quietly on the finger. It is then taught to hop from one finger to another. In this way its training is begun.

Snakes are trained by the natives of India, and no other nation has succeeded in reaching so high a degree of efficiency as these East Indians. The fangs of the snake are first extracted, so as to render it harmless; it is fed on milk, and more or less drugged a good part of the time—as are many other animals which perform in public. The peculiar character of the native music seems to hypnotize the creatures, which, under its influence, emerge from their baskets and are handled with seeming impunity by the natives

Seals are very intelligent animals—despite their looks—and may be taught a number of tricks of an intricate character—tricks requiring a delicate sense of balance and manipulation. Kangaroos also may be taught to box and wrestle with their trainers, and in many ways make excellent performers

The Current Supplement

A SERIAL article from the authoritative pen of Prof H. H Turner, of Oxford, England, begins in the current issue, No 1861, of our SUPPLEMENT The eminent astronomer gives a most interesting account of the history and function of the Great Star Map, in the preparation of which workers all over our globe are taking part —This issue also brings the sixth instalment of Donald Murray's article on Printing Telegraphy —Major Bartlett continues his most interesting discussion of "Logistics," and the problems that arise in taking care of the bodily needs of an army in the field —In an article on "The Dawn of Architecture" Mr John L Cowan brings before us a vivid picture of the first steps in the evolution of human dwellings.—A very remarkable and extremely delicate new test for adulteration of oils with mineral or resin oils is described by A E Outerbridge, Jr —Much has been said and written in late years of the gyroscope and its intentional application to various purposes That gyroscopic effects appear as untavited guests in machinery is a fact which has to be reckoned with on aeroplanes for example This subject is lucidly presented by Mr A Kapteyn —A number of clever "Household Inventions" are reproduced from *La Nature* —Mr E L Thorndyke suggests an ingenious method of quantitative measurement for the quality of literary style, which he applies primarily to the performances of school children.—The mind stands aghast before the figures which must be used to represent the dimensions of some of the objects which the modern physicist measures with comparative ease and certainty. Not so very long ago it was thought a remarkable achievement of the human mind when a numerical estimate of molecular dimensions was gained. Now we have the electron, whose mass is about one eighteen-hundredth of that of a hydrogen atom Prof Pyle of Washington University gives a vivid account of these modern developments.

The German Artificial Sponge

AN artificial sponge, the outcome of German ingenuity, is now to be had. The process of making it consists principally in the action of zinc chloride on pure cellulose This results in a pasty, viscous mass, which is mixed with coarsely grained rock-salt

Placed in a press-mold armed with pins, the mass is pierced through and through until it appears traversed by a multitude of tiny canals, like the pores of a natural sponge The excess of salts is subsequently removed by prolonged washing in a weak alcoholic solution. The artificial sponge swells up with water, but hardens on drying, just like its prototype; it is said to be eminently adapted for filtering water for sanitary or industrial uses, and it can be employed for all the purposes that are usually assigned to the genuine article.

Valuable Books

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By RALPH C. DAVISON. 12mo., 196 pages, 140 illustrations. Price, $1.50.

This book describes in detail in a most practical manner the various methods of manufacture of concrete pottery and garden furniture. A little more than a year ago, concrete, commonly known as cement, was used for the construction of the heavier forms of garden furniture, such as settees, tables, vases, fountains, and similar articles. Now there are shown in the stores, in the book, many handsome designs of these and many other forms, including the smaller forms, like vases, and flower pots, suitable for the indoors. With the methods given in the book, any handy man or farmer can make many useful and ornamental objects to ornament the indoors, most of the home or garden. The information on color work alone is worth many times the cost of the book.

The Design and Construction of Induction Coils

By A. FREDERICK COLLINS. Octavo, 295 pages, 159 illustrations. Price, $3.00.

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Industrial Alcohol Its Manufacture and Uses

By JOHN K. BRACHVOGEL, M.E. Octavo, 328 pages, 107 illustrations. Price, $4.00.

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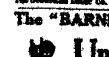


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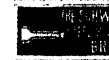
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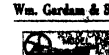


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Electricity

Some Recent Developments in Railway Telephony.—The telephone has been found to possess advantages over the telegraph on railroads, and it is stated that on about 37,000 miles of road the former has now been adopted without any accident having been attributed to its use. This change has been made within the last four years. The three main classes of service performed by the telephone are (1) train despatching, (2) message service, and (3) block-wire service.

Mercury Contact for Railroad Signals.—A novel contact for railway signals has recently been designed, which obviates the necessity of energizing the rails themselves in order that the circuit may be closed by the trucks of the passing trains. The device consists of a treadle secured to the under side of a rail between the points of support. As the rail is flexed under the weight of a passing load, it presses a plunger downward against a diaphragm covering a chamber filled with mercury. Owing to the area of the diaphragm, a very slight depression causes a considerable rise in the column of mercury at one side of the chamber. The mercury thus closes the circuit of the electric signal.

Novel Fan for Dining Tables.—It is always difficult to break away from old ideas. The disk type of electric fan has shown no marked change in design since the day it was first introduced. It still throws a stream of air in a single direction and in order to distribute the cooling effect of the fan to better advantage, various schemes have been devised such as turning the fan bodily or shifting direction vanes before it. An entirely new scheme has now been evolved in which the fan is radically altered. This fan throws a centrifugal zone of air. It is mounted on a vertical shaft and its blades are also vertical, giving it a cylindrical form. As this revolves, it sucks in air from the top and bottom and throws it out centrifugally. A fan such as this placed at the center of a dining table serves to cool all the diners uniformly.

Double Antennae for Determining the Direction of a Transmitting Wireless Station.—If two identical antennae are placed a small distance apart as compared with their common distance from a transmitting station, they perform identical oscillations, so far as amplitude of current and voltage is concerned, but the current and voltage are displaced with regard to each other by a phase difference depending on the distance between the two antennae and the angle which the line joining the same makes with the direction of propagation of the waves. An arrangement consisting of two antennae and two phase meters can therefore be used to ascertain the direction from which the incoming wave is being received. An installation of this kind has been described by Mr. Petit in *La Lumière Electrique*, as is noted in a recent number of the *Génie Civil*.

Aluminium Coils in Traction Motors.—Considerable interest was shown at the International Congress at Brussels, in a paper on the subject of using aluminium in place of copper for the field coils of street railway motors. A number of cases were referred to in which such coils had been in use for several months. In some instances the wire was insulated with rubber, in others with lacquer, while in still others bare aluminium wire was used, the aluminium oxide serving as sufficient insulation between turns, while paper, cloth and the like, were used between layers. The advantages claimed for aluminium, are that it saves 50 per cent in weight for the same resistance, and, in view of the fact that there is a larger volume of aluminium in a pound than of copper, there is a saving of about 50 per cent in the cost of the material. Another thing to be considered in the fact that aluminium coils are much lighter, and hence make a smaller load for the motors to carry, and are less affected by vibration and shock. Furthermore increase in temperature is less destructive because less or no insulation is used. To offset these advantages aluminium coils must have a larger cross-sectional area, and the metal is exceedingly difficult to solder.

Science

Prof. Kossel in the United States.—Prof. Albrecht Kossel, of the University of Heidelberg, arrived recently in this country for the purpose of delivering a series of lectures at Johns Hopkins, and other American universities. Prof. Kossel was awarded the Nobel prize in 1910 for his researches in medical chemistry.

Wireless Weather Reports from Gibraltar.—We learn from *La Nature* that wireless weather reports are now sent every morning from Gibraltar to the Meteorological office in London. The dispatch is copied, en route, at the Tour Eiffel in Paris and promptly sent to the headquarters of the French meteorological service, which includes it in the daily weather bulletin. The use of wireless telegraphy in meteorology is rapidly growing, despite the discouragements that attended the earlier attempts in this direction, and is clearly destined to greatly facilitate the methods of weather forecasting.

Cleaning Cleopatra's Needle.—The Egyptian obelisk which is known as Cleopatra's Needle, which stands on the Thames Embankment, is being cleaned for the first time in its history. For centuries it stood in its native land and never needed the brush. London soot and fumes have begun to mar the face of the obelisk. The obelisk in New York has been protected for years by means of paraffin, in accordance with a method devised by the late Prof. R. Ogden Doremus. London seems to be baffled by the same problem. There seems to be no reason why the Doremus method would not apply.

Loess.—The formation of "loess," a fine yellowish sandy clay found in various parts of the world, and reaching a thickness of over a thousand feet in China, has given rise to much discussion and controversy among geologists. The presence of the shells of snails that feed on plants indicates the former presence of plants. Accordingly it has been suggested that the genesis of these remarkable deposits may be fully accounted for by wind action, coupled with the growth of plants which have caught and compacted the blown dust and sand in the way that sand dune plants do at the present day on our seashores.

The Winds in the Free Air.—In the *Annals of Harvard College Observatory*, vol 68, pt 2, Mr Andrew H Palmer, research assistant at Blue Hill Observatory, publishes a discussion of "Wind Velocity and Direction in the Free Air," based on a great number of kite, *ballon-sonde*, and cloud observations, chiefly at Blue Hill. Comparisons of the wind conditions at various altitudes above the earth's surface are timely, in view of their great interest to the aeronaut. The general principles brought out are: (1) The general increase in velocity with height; (2) the rare occurrence of gusts of wind above low heights; (3) the frequent clockwise and the occasional counter-clockwise change of direction with height; (4) the shallow character of easterly winds (at Blue Hill); (5) the relative frequency of ascending currents as compared with those descending.

The Sizes of Rain Drops.—At a recent meeting of the Royal Meteorological Society Mr Spencer Russell gave an account of the experiments that he has carried out at Epsom during the past two years to obtain a permanent record of the variations in the size of rain drops as they occurred. The first method employed was the exposure of a number of level plates, divided into quarter-inch sections, and gently brushed over with an even coating of oil. It was found, however, that in a heavy rain the drops striking the slate were broken up into a series composed of one large and several smaller ones. A more satisfactory method was that of letting the drops fall into dry plaster of Paris. Mr. Russell exhibited to the society a number of models of rain drops obtained in this manner. He stated that of the drops so far collected the diameters were as follows: 7 of 6 mm., 44 of 5 mm., 73 of 4 mm., 222 of 3 mm., 257 of 2 mm., 175 of 1 mm., and 107 of less than 1 mm.



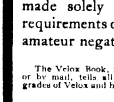
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They are the fruits of Cadillac research; of close and accurate measurement; and of *scientific standardization*

Consider what an augmentation of comfort is implied in these two announcements emanating from the Cadillac Company, which has never promised what it did not fulfill—

First. A surpassingly fine car made infinitely finer, and Second, a hitherto unattainable ideal resolved into a practical reality.

This more refined and efficient car, is a product of that process of ceaseless progress toward perfection, which has prevailed in the Cadillac plant for ten years

The simple, centralized, Delco system of starting, igniting and lighting is merely a phase, or *an integral part of that process.*

To combine these elements of efficiency, for the first time, in a unit, exercising the three separate functions, is of itself an interesting achievement, although such a system as an adjunct to an indifferent car, would be of doubtful value

But to combine them in the Cadillac adds lustre to that achievement, because it *endows an extraordinary motor car with new and beneficial indispensable functions*

Without them, the Cadillac would still be the incarnation of ease, grace, elegance and economy

With them, a new meaning attaches to the word luxury as applied to motoring

The 1912 Cadillac automatically removes itself from the realms of competition

CADILLAC ELECTRICAL SYSTEM

Starting Lighting Ignition

The electrical plant in the new Cadillac not only accomplishes what heretofore has been accomplished in a less efficient manner by separate systems—ignition and lighting—but goes further and includes in its functions a feature to which motorists have long looked forward, an automatic starter which obviates the necessity of cranking by hand

The plant consists of a compact and powerful dynamo operated by the engine of the car The dynamo charges the storage battery

For starting the engine the dynamo is temporarily and automatically transformed into a motor, the current to operate it as a motor being furnished by the storage battery

To start the engine, the operator, after taking his seat in the car simply presses the spark lever and pushes forward on the clutch pedal This automatically engages a gear of the electric motor with gear teeth in the fly wheel of the engine, causing the latter to turn over thereby producing the same effect as by the old method of cranking As soon as the engine takes in charges of gas from the carburetor and commences to run on its own power the operator releases the pressure on the clutch pedal the electric motor gear disengages its connection with the fly-wheel and the car is ready to be driven The electric motor then becomes a dynamo or generator and its energy is devoted to ignition and to charging the storage battery

The storage battery has a capacity of 80 ampere hours and as soon as that capacity is reached, the charging automatically ceases

Practical tests have shown that the storage battery is of sufficient capacity to operate the starting device and turn over the engine about twenty minutes, although it seldom requires more than a second or two in fact the Cadillac engine so frequently starts on the spark that the use of the electrical starter is not always required

The storage battery also supplies the current for lighting The car is equipped with two especially designed Gray & Davis electric head-lights with adjustable focus two front side lights tail light and speedometer light

The dynamo also supplies current for ignition Up to 200 to 600 R P M the ignition current comes from the storage battery above that speed the current is direct from the dynamo through the high tension distributor to the spark plugs For ignition purposes the dynamo performs not only all the functions of the most highly developed magneto, but possesses even greater efficiency having more flexibility and a greater range of action When compelled to drive slowly in crowded thoroughfares over very bad roads or on hills with the usual magneto, the driver may stall his motor because the magneto is not being driven fast enough to generate current and it becomes necessary to switch to the battery If he has one With the Cadillac system if it becomes necessary to drive so slowly that sufficient current is not generated the battery automatically cuts in When the speed is increased the dynamo again automatically takes hold It wholly obviates the necessity of the driver's keeping constantly on the alert to prevent stalling the motor

In addition to the ignition is fore described the Cadillac is provided with the auxiliary Delco system with dry cell current which has proven so satisfactory in the past The extra system is separate and distinct with its own set of spark plugs and in itself is thoroughly efficient for running the car, entirely independent of the main system

The entire electrical plant has been designed with a view to completeness and efficiency It is designed with the idea of simplicity and positiveness It is designed to obviate to the greatest possible degree the necessity of attention Above all, it does what it is designed to do

A few of the improvements in the 1912 Cadillac

Automatic electric starting device electric lights (See detailed description in another column)

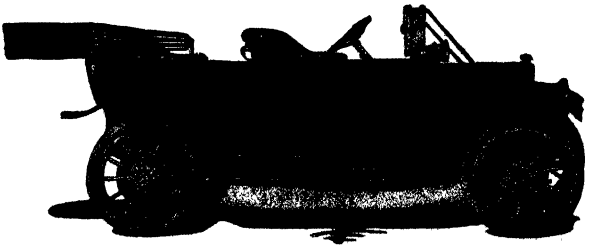
Increased power resulting from motor refinements and our own new carburetor This new carburetor has not only simplified the matter of adjustments, but possesses maximum flexibility and maximum efficiency from low to high speeds without change of adjustment, excepting air adjustment controlled by small lever at the steering wheel.

Wheels and Tires Increased from 34 in x 4 in to 36 in. x 4 in

Brake drums Increased from 14 in to 17 in diameter

Bodies Steel, of latest accepted designs, all fore doors, constructed upon new improved methods.

Gasoline capacity Increased to 21 gallons on all models excepting Phaeton and Roadster, in which the increase is to 18 gallons Gasoline gauge on dash



SPECIFICATIONS IN BRIEF

MOTOR—Four-cylinder, four-cycle, cylinders cast singly, 4 1/4-inch bore by 4 1/4-inch piston stroke. Five-bearing crankshaft. Five-bearing cam shaft. **HORSE-POWER**—Nominal, A. L. A. M. rating, 32 6. Actual horse-power greatly in excess of this rating, due to Cadillac design. Cadillac principles and Cadillac construction **COOLING**—Water, copper jacketed cylinders. Gear driven centrifugal pump; radiator tubular and plate type. **IGNITION**—See description under Electrical System. **LUBRICATION**—Automatic splash system, oil uniformly distributed. **CARBURETOR**—Special Cadillac design of maximum efficiency, water jacketed Air adjustable from driver's seat. **CLUTCH**—Cone type, inner leather faced with special spring ring to fly wheel. **TRANSMISSION**—Sliding gear, selective type, three speeds forward and reverse. Chrome nickel steel gears, running on two annular ball bearings. Bearings oil tight **CONTROL**—Hand gear-change lever at driver's right, inside the car Service brake, foot lever. Emergency brake, hand lever at driver's right, outside. Clutch, foot lever Throttle accelerator, foot lever. Spark and throttle levers at steering wheel. Carburetor air adjustment hand lever under steering wheel **DRIVE**—Direct shaft to bevel gears of special cut teeth to afford maximum strength Drive shaft runs on Timken bearing. **AXLES**—Rear, Timken full floating type; special alloy steel live axle shaft. Timken roller bearing. Front axle, drop forged I beam section with drop forged yokes, spring perches, tie rod ends and steering spindles Front wheels fitted with Timken bearings.

BRAKES—One internal and one external brake direct on wheels, 17-inch by 3 1/2-inch drums Exceptionally easy in operation. Both equipped with equalizers. **STEERING GEAR**—Cadillac patented worm and worm gear, sector type, adjustable, with ball thrust, 14-inch steering post, 16-inch steering wheel with walnut rim; aluminum spider. **WHEELS**—36 inches. **TIRES**—36-inch by 4-inch Hartford or Morgan & Wright. **PAINT**—Fresh, hand-finished. Rear, three-quarter platform. **FINISH**—Cadillac blue throughout, including wheels, light striping, minor mouldings. **GRADE AND EQUIPMENT**—Dynamo with 80 A. H. battery for automatic starter, electric lights, and ignition. Two Delco distributor system. Lamps especially designed for Cadillac cars, black enamel with nickel trimmings: two headlights; two side lights, tail light; Prest-o-lite tank in rear; horn; full foot rail in tonneau; half foot rail in front; robe rail; tire irons; set of tools, including pump and tire repair kit; extra rim in all bodies except closed cars. Speedometer, standard, improved with 4-inch face and electric light.

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Phaeton	1900 00
Roadster	1900 00
Torpedo	1900 00
Coupe, Sedan type, limousine body	2900 00
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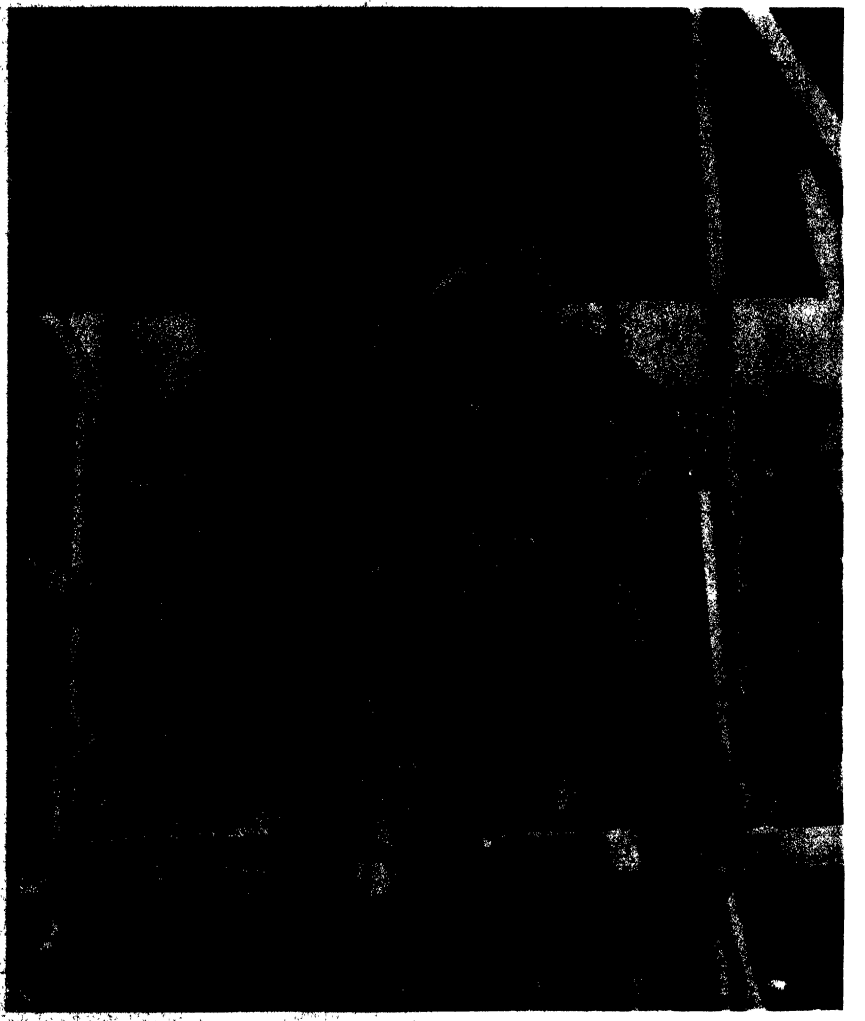
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SIXTY-SEVENTH YEAR

SCIENTIFIC AMERICAN

THE WEEKLY JOURNAL OF PRACTICAL INFORMATION

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Aboard in the Aeroplane in which he flew from St. Louis to Chicago and afterward from Chicago to New York.

THE LONGEST AEROPLANE FLIGHT ON RECORD. [See page 225.]

SCIENTIFIC AMERICAN

Founded 1845

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The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are sharp, the articles short, and the facts authentic, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

The purpose of this journal is to record accurately and in simple terms, the world's progress in scientific knowledge and industrial achievement. It seeks to present this information in a form so readable and readily understood, as to set forth and emphasize the inherent charm and fascination of science.

The "Oregon" a Prototype of the Dreadnought?

MUCH has been said and written, during this present era of big warships of the so-called dreadnought type, about the astounding but nevertheless continual increase in the size and power of armored ships; but it takes such a concrete presentment as is shown in our artist's comparison on another page of this issue of the old "Oregon" of the United States Navy and the new "Lion" of the British navy to bring home to our minds the amazing development which has occurred during the past twenty years.

Turn back to the newspaper files of the early nineties, in which the naval specialist of the daily press was struggling to express his sense of the almightiness of the "Oregon," and you will realize that there was a common belief that the limit of fighting power had been pretty well reached. And there was much ground for the prevailing enthusiasm; for in 1890, the date of the signing of the contract for the "Oregon," there was no ship afloat that compared with her in the weight of metal which could be discharged in a single broadside.

So great has been the advance in the intervening years that the "Lion," with her speed of from 28 to 30 knots and her battery of eight 13.5-inch guns, could meet the "Oregon" and her sisters, the "Indiana" and "Massachusetts," and sink them without running the risk even of serious disablement. With her superior speed, she could maintain a position so far distant, that the 13-inch shells of the older ships would reach her with a diminished striking energy that would be quite insufficient for penetration of her Simpson armor, while at that same range the obsolete armor of the "Oregon" and her consorts would be penetrable by the new 13.5-inch gun.

Comparing the old and the new in detail, we find that the length has gone up from 348 feet to 700 feet, the beam from 69.3 to 86.5 feet, and the displacement from 10,288 to 25,250 tons. The "Oregon" was propelled by reciprocating engines of 11,037 horse-power at a speed of 16.79 knots, whereas the turbines of the "Lion" will probably develop from 75,000 to 77,000 horse-power, driving the great ship at a speed of between 29 and 30 knots. The "Oregon" stowed 1,450 tons of coal in her bunkers; the "Lion" will accommodate 3,500 tons of coal and 1,000 tons of oil fuel. Although the armor on the sides of the "Lion" will be only about half as thick as that on the "Oregon," its resisting power, because of the harder and deeper face, will be greater.

This comparison is made without any thought of disparaging the qualities of the older ship. Indeed, it is worthy of note that the "Oregon" foreshadowed the original dreadnought and all the great ships which have followed her general plan. The European battleship of the early nineties carried four big guns as the main armament, and then dropped into the feeble five and six-inch guns as a secondary armament. The 8-inch, armor-piercing guns of the "Oregon" were a distinct innovation; and it is certainly but just to the naval designers of the United States navy of that day to credit them with having suggested the advisability of an all-big-gun armament as the best suited to the line of battle. The editor, indeed can remember more than one personal discussion of the subject with officers of our navy who protested against the elimination of the 8-inch gun from the "Maine" class of battleships, and urged that the substitution should have been rather of 10-inch guns than of 6-inch for the eights which were carried on the "Oregon."

"The World Patent"

IN speaking before the annual meeting of the Society of German Chemists last June, Dr. E. Kloeppel chose for his subject the "World Patent," and discussed the question of what could be done in Germany at the present time toward the ultimate realization of a universal patent of international validity. While it would be quite unreasonable to be at all optimistic with regard to the early realization in full of such an idea, the speaker pointed out that this is no reason why such steps as are within reach should not be taken to proceed at least some small distance in the direction toward the ultimate goal. Much of what Dr. Kloeppel said is of great interest to the inventor and patent lawyer, and some of the salient points of his address are outlined below.

Dr. Kloeppel first of all pointed out that when we speak of a world patent we tacitly limit our ideas to the countries of the International Union, which of course enter first into consideration. In this connection it is interesting to note a communication published by Damme, that the French government made a proposal at the diplomatic conference of the States of the International Union recently assembled at Washington, according to which all patent applications in the countries of the Union are to be registered at the Bureau in Berne. This plan would be easily carried into effect (as has already been done with regard to trade-marks), if all the countries of the Union followed the French system of patent application without preliminary examination. In view of this it is not surprising that the first detailed publication on the "World Patent" should come from the pen of an energetic opponent of a preliminary examination. Du Bois Reymond opens his book with the declaration that he would look upon a final victory of the preliminary examination process as a "victory of the irrational over the rational." Dr. Kloeppel himself does not follow Du Bois Reymond in this matter, though admitting that the latter's publication contains much which will help to create a receptive spirit toward the idea of the "World Patent," even though its full realization may be a very long way off.

Starting from this basis we may briefly examine what possibility there may be of simplifying the process of examination in connection with patent applications by the aid of international agreement. The chief problem here is to determine how far the actual work of examining, which under the present system is repeated in each country in which an application is filed, could be performed once for all by one country, and the results made available for use in dealing with the applications in other countries.

At the present time England, Austria, Portugal, the three Scandinavian States, Japan, Germany, and the United States have a preliminary examination. As a matter of fact, the objective treatment of the problem of examining differs much less even now in the several countries than is commonly supposed. It is not by any means true that the more important States have the most rigorous examination. Thus, the Scandinavian States have a very strict and thorough examination. Du Bois Reymond proposed that the unnecessary duplication of the examining labor be reduced by the establishment of closer treaties between the individual countries. For instance, the first step might be taken by Germany making an agreement with Austria that all German patents should without further parley be valid in Austria, and *vice versa*. There are, however, considerable difficulties in the way of such a plan, and in fact arrangements of this kind have existed in the past but have been subsequently abolished. The kind of trouble that would be likely to arise can be foreseen if we consider for example the fact that a given patent would be construed by German courts, while it could be set aside only by Austrian authorities.

Another plan which tends in a somewhat similar direction, but could probably be more readily carried out, is suggested by the following considerations:

At a time when Austria had not joined the Paris Convention, and the German-Austrian Treaty of 1891 was still in force, a joint applicant would, as a rule, wait until his German patent was completely examined and issued, and would then apply for a patent in Austria, receiving by the terms of the treaty the benefit of priority in accordance with the date of his German application. So far as can be ascertained, it hardly ever occurred that the Austrian Patent Office—which has a very rigorous examination—refused to grant such patents or even cited new matter against them. It may therefore be said that practically the Austrian Patent Office granted patents on the basis of the German preliminary examination. As a matter of fact, under present conditions, since Austria has joined the Paris Convention, and the German-Austrian Treaty of 1891 has been rescinded accordingly, considerable changes have taken place, and a German applicant is in general forced to file his Austrian application before his German patent is issued, in order to obtain the benefit of the twelve months allowed for priority rights by the Paris Convention. There appears to be no cogent reason why the admission of Austria to the Convention should set aside the previously existing treaty. This latter might therefore be renewed and a clause might be added which would obviate the duplication of the examining work. There would be no occasion for any solicitude that, for instance, the Austrian examination should be less stringent than that in Germany, for in practice this is found not to be the case; indeed, instances are known in which rather the reverse is true. Moreover, any possible error which might arise would be automatically corrected in the subsequent "Einspruchsverfahren" which forms part of the regular procedure both in Germany and Austria in the course of obtaining a patent.

If a treaty of this kind were made first of all between two countries such as Germany and Austria, which are closely related politically and in point of patent law, no doubt the desire would soon be felt among other nations to enter into similar agreements. Possibly when the advantages of such a plan become fully realized, other nations, whose patent laws differ more widely from those of Germany, might be persuaded to take similar steps.

The suggestions made by Dr. Kloeppel are of course framed entirely from the German point of view, and allowance must be made for this in considering them. Possibly, too, they may appear somewhat optimistic. Nevertheless, there can be no doubt that the general principle of such an aim at unification is thoroughly sound and presents an ideal which it is desirable for all nations concerned to set before themselves.

The Term "Anticyclone"

OUR English cousins are never truly happy unless they have some subject—the more academic and unpractical the better—to wrangle about in the daily press. We learn from *Symons's Meteorological Magazine* that a vehement controversy has been raging in *The Times* over the appropriateness or otherwise of the word "anticyclone," which was evolved from the fertile brain of Galton nearly half a century ago, and has since been almost universally applied by meteorologists to a system of winds blowing about a center of high barometric pressure—a "high," as it is called colloquially; the reverse of a "cyclone," or "low."

One correspondent, Mr. Pearsall Smith, suggested that an anticyclone should be called a *halcyon*, with reference to the fabled condition of the weather about the time of the winter solstice, when the halcyon was supposed to be brooding on its floating nest. Other writers, whose ideas as to the characteristics of an atmospheric high-pressure area were more or less hazy, suggested such alternatives as "calm," "air-calm," "wind-wyr," and "plenum." The first two of these are interesting as indicating that the English public is quite as much at sea as the American public concerning the proper meaning and application of the word "cyclone." The whole controversy was extremely puerile—and the word "anticyclone" is in no danger of vanishing from the meteorological vocabulary—but it is interesting as an illustration of the discussions of scientific questions by unscientific people that are rather common in English newspapers.

We may suggest that these writers might use their ingenuity to better purpose in trying to devise some acceptable substitute for the word "cyclone" in its application to a cyclonic storm. In doing so they would be following the example of certain German meteorologists who, in the last few years, have endeavored to establish a distinction between the words "*Zyklon*" and "*Zyklone*," the former meaning a violent whirling storm, and the latter a cyclonic system of winds in general.

Bion Joseph Arnold

An Engineer Who is the Right-hand Man of Public Service Commissions

By Thomas Commerford Martin

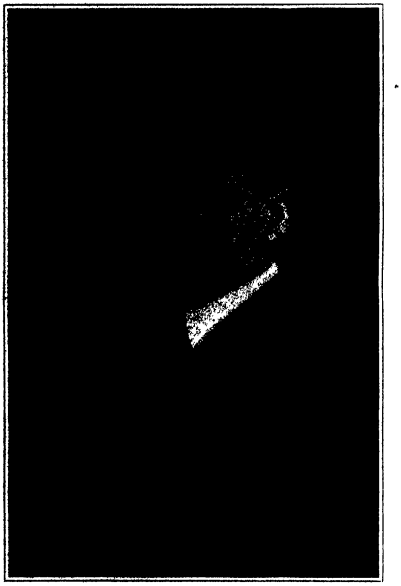
PUBLIC service commissions feed out of his hand. Public service corporations rise up and call him blessed. A court or a master in chancery is perfectly willing to accept his report on the value of a big property, as the basis for rates or new securities; and the banker is ready to accept his verdict in making large investments. There is something fundamentally fair and equitable in his mental make-up that leads to a profound confidence in his trustworthiness and ability, explaining all this. Had he been a lawyer, Arnold would have been an ornament to the United States Supreme Bench, but he would never have filed a minority opinion. He has a profound conviction as to his own insrrtincy, but believes that eleven men are more likely to be right than one. Moreover, Arnold would probably never have been satisfied with the income of a judge. Out of clean, straight engineering he makes every year as much as all the bench in Washington put together—more in one year than his father, an able lawyer, made all his life.

The Arnold family began in Rhode Island; so far as this continent is concerned, and records of the eighteenth century show a due profusion of Jeremiahs and Ichabods, which makes one look to the culture of his parent to understand how this man came to be named after a Greek bucolic poet. Anyhow, Bion J. was born at Cazenovia, Mich., August 14th, 1861, but aroused to a consciousness of things American further on westward, for his father had become a pioneer of Nebraska and a member of the territorial legislature of 1865-6. It is something to be among the founders of the great western commonwealths. Nebraska was then rather raw, and there were many struggles and privations for the newcomers on those endless dismal, but fertile stretches of black soil rolling toward the sunset from the banks of the turgid Platte. Young Arnold was never agricultural in his tastes—and, as Edison has said from first-hand observation, hoeing corn has explained the growth of many large cities. But Arnold showed his native bent by devising new types of farm machinery as a boy of six. By the time he was fifteen he had built a piston valve steam engine; when seventeen he built from an advertising cut in the *Youth's Companion* a bicycle, equal to any boneshaker of the period; and a year later he had made a complete miniature locomotive. By this time he had become a student in the Embryonic University at Lincoln, and began spending winters in college and summers as traveling expert for engine companies, or as instrument man with civil engineering parties. He graduated B.S. at Hillsdale College, Michigan, in 1884. M. S. in 1887, and M.Ph. in 1889, but was not satisfied until he had taken a post graduate course at Cornell during 1888-9. It would require some space to record his other degrees and university honors, among them being the Honorary degree of D.Sc. from Amwell Institute in 1909, but Arnold is not unlike many other engineers of distinction who are keen for the fact, but care little for the educational means by which they master knowledge. Arnold's mind is an encyclopaedia of engineering data, but those data are ever too fresh to take on the antique form of erudition.

For several years, Mr. Arnold did odd engineering jobs and lots of constructive work, settling down at last in the electrical field; building as consulting engineer in 1892-3, at the Chicago World's fair, the first electric elevated railroad in the country. He dabbled in storage batteries with engineering and financial success that startled onlookers; and then developed much of the modern electric railway practice; including the pioneer A. C. and D. C. railway between Chicago and Milwaukee in 1897-8 and the pioneer single phase line in 1904-5 at Lansing, Mich. All this involved invention, creative ability, engineering skill and personal courage of a high order—and at the end of a very short period Arnold had lifted himself to leadership in the new profession, ready for the next development.

Every student of invention and engineering knows that while the last century was taken up chiefly with the inventions that have given the world its modern facility utilities, neither the inventors nor the public have ever actually alive to the tremendous facts that now arrest attention universally—the political, economic and sociological relations of those inventions to the real welfare of the people. The awakening has been sudden and recent. We were all part of that formative regime, sharing and condoning, but we shall never go back to it, necessary and inevitable as it all was in the creation of the civilization of to-day, based so largely on inventions and arts unknown a century ago.

The chief danger now is that in the recoil of the public mind from what it once advocated and accepted so freely, vital injury may be done to the industries upon which the convenience and comfort of all depend, by reason of the restrictions placed upon the free play of individual genius and upon the opportunity offered to capital. Here comes in the vast significance of Arnold's work in what may be called his later style. He



BION JOSEPH ARNOLD

is arch adviser to the regulating and supervising bodies called Public Service Commissions, and has found a function of extraordinary usefulness in formulating the rules of the new game, in showing what is fair play, in getting a square deal for the public, in insisting upon the right of the investor to a reasonable return on the money which has helped make possible some service that crowded populations have greatly needed. Now Arnold has all the qualities of a real umpire, and might even win popularity on the baseball diamond. He knows himself, from experience, the tears and blood wrung from an inventor in reaching the goal. He has shared in the risks and discouragements of a new industry. He has helped to administer properties and knows the portentous seriousness of the problems confronted. On the other hand his temperament is judicial, his sympathies are broadly democratic, he believes that the public very often has had more coming to it than it was allowed to get under the old regime, and he is first, last, and all the time a staunch and eloquent upholder of the doctrine of the vigilant but fair regulation of utilities working under public charter and enjoying public concessions of one kind or another.

For five years Mr. Arnold was a member of the Electric Traction Commission that banished the steam locomotive from New York city and brought in the glad new era, with work running to an expenditure of $60,000,000. In 1902 he was engaged by the city of Chicago to help rehabilitate its old traction system and devise new ones. This meant valuations and studies on a gigantic scale, and since 1907, Arnold has, under direct ordinances, been chief engineer there, controlling construction operations that aggregate a cost of $65,000,000. About the same time he had charge as consulting engineer of the electrification of the Sarnia tunnel of the Grand Trunk railroad and was a member of the Commission to prepare plans for electrifying the Erie Railroad. In 1908 as consulting engineer to the Public Service Commission of the First District of New York State he made a brave essay to solve some of the mighty problems involved in the operation of the congested Interborough subways, and many of his recommendations, such as side doors for cars, speed control signals, lengthened station platforms, etc., have since been adopted resulting in great increase of capacity and earnings. With this went a lot of appraisals for the Commission of all the surface railways. In 1910 he made an intensely interesting report on the traction conditions of Pittsburgh and during the same year was appointed chief subway engineer for Chicago, preparing a report presented last February. This year he has made for the city authorities of Providence, Rhode Island, an elaborate study of the local transportation needs, and at the moment is engaged in sizing up the complicated situation at Los Angeles, Cal., where all kinds of traction services have to be tied in and coordinated for better results to traffic and commerce. These and other such jobs are large sized propositions for a big man, but Arnold measures up to them very comfortably.

While his reports are masterly in their exhaustiveness and models of completeness, Mr. Arnold's speeches and addresses when he lets himself go, are breezily western and none the less delightful. He can't help thinking clearly. As president of the American Institute of Electrical Engineers and of the Western Society of Engineers, his executive talent shone to great advantage, and as a member of many societies, clubs and civic bodies he is loyal, generous and ever companionable.

Illuminating Pistols in the German Army

DURING the recent extended manœuvers of the German army there were many night attacks, in which use was made of the newly introduced illuminating pistols. According to the new regulations these are to be employed wherever the configuration of the land makes their use preferable to that of the ordinary search light. The machinery necessary for the use of the latter device is very inconvenient, and especially in rolling and otherwise difficult country where the main maneuvers take place, it cannot be used to advantage. The illuminating pistols have not this disadvantage, as they are easily transported. Further, the searchlight is useless in valleys and deep lying plains, as their rays shoot over these and leave them apparently in still deeper shadow. For this reason, such valleys serve as excellent covers at night, against the searchlights. The illuminating pistols have done away with this advantage of shelter as the cartridges which they throw light up the deepest and darkest gulleys.

There are two different sorts of cartridges, producing respectively white and red light. The white ones serve exclusively for illuminating the country, the red ones for signaling purposes between widely separated commands or divisions even where the distance between them is several kilometers. The illuminating cartridges develop a light that makes everything within 200 meters (656 feet) visible, and lasts eight to ten seconds.

An English Plea for Aerial Navigation

THE Aerial League of the British Empire held a meeting at the Mansion House on May 24th at which it was decided to inaugurate a special coronation appeal for $1,250,000 for the establishment of a national institute and school of aeronautics.

The Opening of the Radium Institute in London

A Red Letter Day in the Annals of Medicine

IT will be remembered that the late King Edward took a keen personal interest in the advancement of cancer research, and that he was also an enthusiastic supporter of the movement for the establishing of a special radium institute in the metropolis, where the study of the application of radium for the cure of cancer and for other therapeutic uses should be carried on. The realization of this institute became possible through the generosity of Viscount Iveagh and Sir Ernest Cassel, and the official opening of the new establishment took place on August 14th.

The radium institute is equipped with all the modern appointments required for successfully carrying on what promises to be one of the most important branches of medical research. Our illustrations give only a few samples of some of the special apparatus installed. The most important asset of the institute is of course its stock of radium, amounting to 1 gramme and valued at $75,000. Among the special instruments of the institute may be mentioned a very fine chemical balance which weighs to one-thousandth of a milligramme (about one hundred-thousandth of a grain), and a very remarkable microtome, or microscope section cutter, which will make no less than 25,000 slices from one inch of material. Its extreme fineness has been graphically described by saying that it would cut a blood corpuscle into eight pieces.

The application of radium for therapeutic purposes is still in its infancy, but some of the results obtained are most encouraging, and the present juncture seems a fitting occasion to pass in brief review some of the principal methods employed and effects observed upon the healthy and diseased organism.

Radium rays have an unmistakable bactericidal action both in artificial cultures and within the organism. As may naturally be expected, the effect increases with the amount of radium and the three kinds of rays the alpha, beta, and gamma rays act in proportion to the extent to which they are absorbed, the highly penetrating gamma rays being least effective. A rather peculiar effect has been observed in the case of luminous bacteria, a small mass of radium contained in a luminous bacterial culture appeared surrounded by a small dark area, due presumably to bactericidal action. Immediately surrounding this dark area is a ring of increased brightness. The cause of this stimulating effect is unknown. According to some observers radium rays diminish the virulence of rabies toxin, but Vanyez found the rays ineffective when applied to a fresh preparation of the spinal cord.

As regards the medical application of radium treatment this has hitherto extended principally to skin affections, ulcers, tumors and cancers. In the treatment of vascular tumors the radium salt is mixed with finely powdered barium sulphate, and spread with varnish in a thin layer on a metal plate. This is conveniently mounted upon a handle, and then presents the appearance shown in our illustration. The treatment, as described by A. C. Jordan in a review in *Nature* of Prof. Gaucher's book on Radiography, consists in the application of this disk to the diseased portion, the dose being regulated according to the form and extent of the tumor. Another method is to give smaller doses filtered through screens which absorb the less penetrating rays, longer exposures being in this case given. The results obtained are very satisfactory, and on the whole, better than those secured by any other means. In the treatment of scar tissue tumors very favorable results are obtained both by X-ray and by radium treatment, but radium is less liable to cause inflammatory troubles.

The activity of radium is usually expressed in terms of that of uranium. If the latter be taken as the unit, the activity of pure radium is two millions. In mixtures of radium and barium salts, the activity of the mixture is inversely proportional of the quantity of the barium salt present. In the treatment of cancerous tumors, preparations of an activity of 500,000 are used, consisting usually of four to ten milligrammes of powder containing one part of radium salt to three of barium salt. Cancers suitable for radium treatment range from those of small size to those of 20 to 30 square centimeters in area.

Deep-seated cancers are subjected to a special treatment, the rays being filtered by passing through a thickness of lead ranging from one-half to several millimeters. This permits only the highly penetrating rays to enter the tissues. Long exposures varying from 24 to 120 hours are given. It is found that the highly penetrating rays produce very little change in the healthy cells, while they have a selective action upon the cancer cells, causing their destruction. The progress of a successful case is described by Mr. J. Jordan in the review quoted as follows.

"After a short time (three to eight days) the tumor commences to diminish in size. Cicatrization then begins and is completed in two to four weeks, or longer in obstinate cases. In the case of ulcerating tumors, a certain amount of discharge occurs during all the stages. For large and deeply-extending tumors the method of 'cross-fire' is usually employed, two or more radium apparatus being applied at different points around the tumor in such a way that the ultra-penetrating rays cross in the depths of the tumor. In this way the deeper parts of a growth can be subjected to the influence of the gamma-rays far more effectively than with a single disk of radium."

In addition to the method of treatment described above, various other modes of procedure have also been proposed and practiced with varying degrees of success. Among these, it is interesting to note in particular the therapeutic use of radio-active baths, inasmuch as the supposition naturally suggests itself that some of the natural waters famous for their healthgiving qualities, owe these to the presence of radio-active substances. This subject has been much discussed, and it will suffice to remark here that probably the action in such cases takes place by inhalation of the emanation arising from the water.



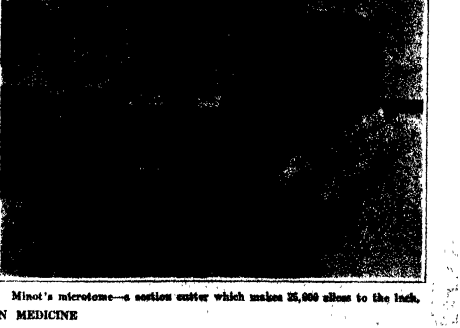
A corner in the physical laboratory of the new radium institute



This balance weighs to one thousandth of a milligramme (about one hundred-thousandth of a grain).



The varnish on this disk contains $4,000 worth of radium.



Minot's microtome—a section cutter which makes 25,000 slices to the inch.

RADIUM IN MODERN MEDICINE

Atwood and His St. Louis-New York Flight

A Record Full of Promise

ONLY a few years ago, Prof. Simon Newcomb, an authority who was quoted the world over, branded the heavier-than-air flying machine as a mechanical absurdity. "I consider the demonstration that no possible combination of known substances, known forms of machines, and known forms of force, can be united in a practicable machine by which men can fly long distances through the air, as complete as it is possible for the demonstration of any physical fact to be," was one of his dicta. He followed it up with the statement: "Let us discover a substance a hundred times as strong as steel, and with that some form of force hitherto unsuspected, which will enable us to utilize this strength, or let us discover some way of reversing the law of gravitation, so that matter may be repelled from the earth instead of being attracted to it, and then, and not till then, we may have a flying machine." To drive home his conviction as far as possible, he concluded, "There is every reason to believe that mere ingenious advances with our present means and forms of force will be as vain in the future as they have been in the past."

What would Prof. Newcomb say if he were now alive? What comment would he make on the flight of a young man from St. Louis to Chicago and from Chicago to New York in a machine that did not involve the discovery of new forces or material, in a machine which was as subject to gravitation as a thing of metal and wood and canvas can be?

It may be said that Atwood's performance unquestionably proves that the flying machine has a future for swift transportation, when speed is more to be considered than cost. Atwood assures us that his expenses were $900 a day. Even if they were but a tenth of that, only a Wall Street banker who must travel from his office to Chicago swifter than a railway train can now carry him, and then because millions are perhaps at stake, can afford to pay such an exorbitant price for the transportation of his brains to the spot where they are needed. On the other hand, there is every reason to believe that so long as men like Atwood, Beaumont, Vedrines, and other present day champions of the air, race for purses that hold thousands of dollars, no attention will be paid to reduction of operating costs. When the public has wearied of aviation meets (and there is evidence that in Europe at least the cross country flight has completely displaced performances in an inclosure for the benefit of thousands in the grandstand and on the field), when newspapers have extracted all the notoriety they can by offering huge sums for successful flights between cities remote from one another, the engineer will step in and provide us with machines and engines that will transport us through the air at a cost no greater than that of a present-day automobile tour. So long as $900 a day is the cost of a flight from Chicago to New York, so long will the aeroplane be the exclusive property of aerial performers with itching palms.

In last week's SCIENTIFIC AMERICAN, we commented editorially with such fullness on Atwood's historic flight that we can do little more here than to call attention to its more salient features. In the first place, it must not be forgotten that Atwood started from Chicago after a 286-mile flight from St. Louis, made in one day at a speed of 46¼ miles per hour. That he should have flown day after day with but one mishap, speaks well for the aeroplane, although we suspect that inasmuch as the type of machine with which his victory is identified has been in existence for over a year, a large part of his success must be attributed to personal skill. To him belongs the distinction of having made the longest continuous flight on record, covering, as it did, 1,265 miles in a total flying time of 29 hours and 35 minutes, corresponding to an average speed of 42.76 miles an hour.

Of his experiences in this remarkable jaunt he says:

"My only trouble in all the 1,265 miles was a stalled motor. Think of the spots where I landed. At Lyons, N. Y., it was on top of a hill; at Amboy, west of Syracuse, it was in a marsh; at Fort Plain it was in a rocky meadow, upon the top of a mountain; at Castleton it was on a steep slope along the bank of the Hudson; at Glen, where I stopped to make repairs, it was on the top of a mountain 1,250 feet high. At Cold Spring, across from West Point, I had to climb the side of another mountain, and landed right plump on the top ledge with only a ten minutes' supply of fuel."



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Atwood landed at Nyack in a small field from which he could not start.

Atwood accomplished his journey in 20 flights of an average of 63¼ miles each, with but a single forced descent at Nyack. A less steady hand and poorer judgment might have wrecked the machine at that particular time, for Atwood alighted on a piece of ground so small in area that it was impossible to start from it after the necessary repairs had been made to his motor. As it was, a few trees had to be removed and his machine had to be carried bodily to a position more favorable for starting. His Nyack mishap drives home the inevitable truth that the motor is the most vital part of the aeroplane. Until engines are absolutely reliable the aeroplane can hardly become the popular pleasure vehicle except when fitted with floats and flown above water courses where it can alight safely in case of accident.



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Carrying Atwood's aeroplane to a more favorable starting place.

ATWOOD AND HIS ST. LOUIS-NEW YORK FLIGHT

A Competitor for the Trans-continental Flight

ONE of the recent graduates of the Wright school at Dayton, Mr. Robert G. Fowler, of Los Angeles, Cal., has entered the trans-continental race for the $50,000 prize offered by a New York newspaper.

The rules require that notice of the entry be given two weeks before the start that the journey must be made in 30 consecutive days, and that the start must take place before the 10th of October next. The flight may be made in either direction. Mr. Fowler has decided to follow the northern route of the Southern Pacific railroad, since by so doing he will not be obliged to fly over such long desert stretches and will at no time be over 50 or 75 miles from a town or village. The total distance over the desert amounts to 335 miles. It is planned to have a special train accompany him carrying three extra motors and complete machines. The most dangerous part of the trip is the 75 miles across the Sierra Nevada mountains from Colfax, Cal. to Reno, Nev., and the 57 miles across the Rockies from Laramie to Cheyenne, the elevations reached in these two places being 7,014 and 8,010 feet. The railroad runs along the mountain side many miles through snow sheds and a landing without disaster would be an impossibility throughout these stretches. Nevertheless, Mr. Fowler hopes to have as good luck as did Vedrines in flying over equally dangerous country in the Paris-Madrid race, and the route he has chosen gives him a saving in distance of 1,800 miles over the southern route, the total distance by rail being but 3,210 miles.

Scientific Developments in Aerial Navigation

Army Aeroplanes; New Air Maps; Submarines and Aeroplanes

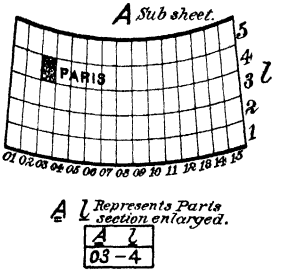
Army Aeroplanes in France

THE question of organizing an aeroplane service for the army is occupying much attention in France at present, especially in view of the coming military maneuvers which will take place in the fall M Messimy the new Minister of War, is taking active measures to make use of aeroplanes in the best possible way The maneuvers will no doubt bring out many useful points, and at the same time will give some further data for organizing an aeroplane corps for the army Steps are already being taken to do this One plan is to have a reserve aeroplane corps which does not belong to the active army, but can be called into requisition when it is needed Last year a number of pilots were called upon for an aeroplane service in this way, among others Latham, who then resumed his army position of lieutenant, and Breguet and other pilots acted in the same way This year will see a greater number of well known pilots who have made their records within a recent time, among others Vedrines, and they will take part in various operations during the maneuvers In principle, the pilots go through their annual period of 28 days which is required of all private citizens up to a certain age They will therefore not receive any money compensation, but will be rewarded by honorary distinctions or rise in grade It will be remembered that Latham, Leblanc and others already received decorations owing to their performances in the military service A point to be considered is how to recruit the aeroplanes themselves The Minister considered at first that this could be done by having one or several aeroplanes kept in hand by each constructor so that they could be called upon for use in the army in case of need, and the constructor would also furnish the pilot, receiving an annual premium of $1,000 for the aeroplane However, this plan has its drawbacks, as we find that aeroplanes are being quickly improved at present, and they would likely be out of date very soon This reason led to considering another plan, that is, a requisition of the aeroplanes from their owners such as has already been decided upon for automobiles, and as each citizen is already considered as nominally belonging to the army it is natural that he should bring his machine into service at the same time should this be needed At all events, whatever may be the plan adopted, it is certain that active measures will be taken to organize the aeroplane corps On the other hand, the Navy Department is taking steps in the same direction M Delcassé, the new Minister of the Marine, considers it best to take the pilots which are trained by the War Department in its various establishments, in order to avoid multiplying the number of training grounds The Navy Department will then proceed to purchase the aeroplanes which it needs Commandant Daveluy, a prominent naval officer, is already appointed as chief of the aeroplane service, and he formerly distinguished himself by his treatises on naval tactics The headquarters will be at the naval port of Toulon where is stationed the Mediterranean fleet, and aeroplane grounds have been already laid out near the naval docks We already mentioned that aeroplanes are to be one of the features of the next naval maneuvers and they will be used in connection with battleships and submarines Now that Aubrun found that he could sight a submarine when under water this will no doubt be made one of the features of the maneuvers, and some interesting results may therefore be expected

An International Aero Map

By Our Paris Correspondent

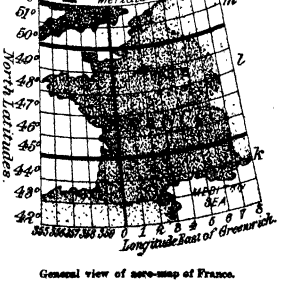
WITH the modern progress of aeronautics, and especially with the coming of the aeroplane, the need of specially adapted maps to serve as a guide to airmen has become strongly felt What is wanted is essentially a clear and thoroughly readable map from which the pilot can gather everything he needs, while all unnecessary and confusing detail is omitted This, however, is not enough We must have large conspicuous signals laid down on the ground and on the roofs of buildings Prof Alphonse Berget, the noted Paris scientist, the head of the department of Physical Geography at the University, gives the following account of the recent meeting of the delegates of the International Aeronautic Federation, which assembled at Brussels to discuss these questions The chair was taken by Prince Roland Bonaparte and all the leading countries were represented America sent Mr Edgar W Mix; the German representatives were Mr Hildebrandt of Cologne, and Dr Berson, the holder of the world's altitude record, Commandant Von Frankenburg and others The Austrian delegates were Commt. Th Schelmpflug and Dr. Peucker of Vienna. Belgium was represented by Col Jeanne, Mr. F Jacobs, President of the Aero Club, and others Among the French representatives were, in addition to the chairman, Prof Berget, Mr Serven and others. It was decided from the beginning to deal separately with the two questions of the map and the ground signals, equal importance being attached to each. The subject of the map was taken up first, and, thanks to the friendly feelings and unity of views which prevailed at the meeting, excellent progress was made It was decided that each country should prepare an aeronautic map upon a standard scale of 1:200,000, and further that the map of each country should be sub-divided and cut up into small sections correspond-



The Paris sub-section showing the method of designating the sectional parts.

ing to degrees of latitude and longitude The longitudes are numbered from the Greenwich meridian and the latitudes from the equator.

The French map will be drawn up along the general lines laid down by Commt Talon This method has been adopted by the Aero Club on account of its great clearness, after consultation with some of the leading experts France will be divided into 75 sub-sheets, each measuring 16 x 24 inches These sheets will be laid out according to the polyconic projection method previously adopted for the 1 100,000 map of the Department of the Interior and also for the world map To facilitate the proper assembling of the sub-sheets, they will be grouped together in a large rectangle, and each rectangle will be indicated by two letters A capital letter denotes the longitude The letter "A," for instance, includes the section lying



General view of aero-map of France.

between the meridian at Greenwich and 8 degrees east longitude. The small letter on each sheet refers to latitude, one sheet taking in five degrees. Thus, for example, the sheet "A l" takes in the greater part of France and includes a number of sub-sheets. All the sub-sheets bear the letters "A l." The main sheet is divided into seventy-five sub-sheets, each including one degree of longitude and five degrees of latitude and carrying at the bottom a number from 1 to 15 for longitude and at the side a number from 1 to 5 for latitude Thus the sub-sheet upon which the city of Paris shows is designated A l 03.4. It is these sub-sheets, measuring 16 x 24 inches, which the aeronaut will carry with him on board. Each country is to draw up its own maps with reference to this general plan, but is at liberty to choose its own method of indicating the details, except that electric power lines will be shown by lines of red crosses.

As regards the second point under discussion, namely, the ground signals, it was decided that the matter could not be properly dealt with until more experience had been gained with different kinds of signals.

Submarines and Aeroplanes

SOME very interesting experiments have just been carried out in Cherbourg, to test the capabilities of an aeroplane in detecting and locating submarine craft. The aviator who flew the machine in these tests was Aubrun, the well-known champion, who volunteered to give his services, saying that he was convinced that he could sight a submarine even when submerged at some depth from the water. The machine he used was a Deperdussin. A series of experiments was organized in which two torpedo boats and two submarines took part, as well as a steam tug designed to take the aeroplane. All the trials took place on one day, with a light wind and calm sea, and comprised two different sets of experiments In the first set, the aviator was told the approximate location of the submarines. Aubrun had no difficulty whatever in locating the first submarine, which was partly out of the water On the approach of the aeroplane it plunged and disappeared. The aviator then went in search of the second submarine and located it under water at a distance of about two miles from the first During these trials, which took place about three miles out at sea, Aubrun rose first to 600 feet and then flew at a thousand to twelve hundred feet The second trial was more difficult, but lead to complete success. In this case no indication whatever was given as to the location of the submarines, which were submerged under water. Aubrun made a fresh start from the ground and then rose to a height of about one thousand feet, sailing in large circles of 1,500 to 1,800 feet diameter over the sea. The sun was very low by this time, making it harder to view the sea bottom Before long Aubrun discovered the light reflected from a periscope, and after that it was a comparatively easy matter to locate the submarine, which appeared as a black mass moving at about 20 feet depth Auburn then returned to the ground after having been up about 20 minutes. It appears to be now beyond question that an aeroplane flying as high as 3,000 feet from the earth can detect a submarine, while on the other hand the periscope of a submarine will not give a recognizable image of a flying machine at more than 1,500 feet However, it is not altogether an easy matter to locate a submarine when the aeroplane is flying high, and the pilot must be specially trained for this work. In view of the very favorable results obtained so far it is intended to continue the trials which have been begun. For the purpose of locating submarines and torpedo boats probably a rather slow aeroplane flying at about 50 miles an hour is quite sufficient. On the other hand for scouting purposes a very rapid flyer is needed. What is particularly wanted at the present juncture is a set of maneuvers in searching for submarines lying at a depth of 60 to 100 feet under water, the aeroplane flying at different heights, and under conditions both of still water and rough seas. Floating mines also are to be searched for, and combined maneuvers, in which battleships, torpedoes, submarines and aeroplanes take part should form part of the programme. When the aviator has discovered a submarine, he discloses its location to a torpedo boat by dropping a buoy into the water.

The Population of London

ACCORDING to the latest census returns for the administrative county of London, the total population for Greater London is 7,283,982. The area of the administrative county of London is 116.3 square miles, The area of Greater London, which includes all parishes within 11 miles of Charing Cross, is 693 square miles. In 1910, the five boroughs of New York boasted of 4,776,883, although the population is now estimated at more than five million.

Correspondence

[The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.]

Wolf's and Brook's Comets

To the Editor of the SCIENTIFIC AMERICAN:

The following observations of Wolf's and Brooks's comets, respectively 1911 c and c, were made on the evening of August 20th, 1911, with the aid of the 40-inch refractor of this observatory.

Wolf's comet first observed; very apparent in the 40-inch, and in a rich field. Small Slight indication of a nuclear condensation. Near a small star.

Brooks's comet was observed, first with the 4-inch finder of the great telescope The nuclear condensation was a little more apparent than on previous evenings, but the comet was generally about the same. Secondly, with the telescope: The nucleus and matter extending in all directions from it were all that were visible at one time, on account of the size of the field of view; the former, however, presented a fairly large disk and was nebulous in appearance. The light of the nucleus was practically white. There were several comparatively bright stars in the same field, which were actually visible through the head of the comet, apparently undergoing no loss in brilliancy whatsoever. The field itself was very luminous, and in some parts the nebulosity was more apparent than in others, which fact indicated the presence of a tail extending out into space, beyond the head of the comet. FREDERICK C. LEONARD.

Yerkes Observatory, Williams Bay, Wis.

A Merchant Marine Suggestion

To the Editor of the SCIENTIFIC AMERICAN:

I wish to express my appreciation of your Merchant Marine number. I have read each of the five articles twice and find them great educators. But I note with sadness that your lay readers, the common people of the United States, upon whom rests the duty of deciding this whole matter, are not taking advantage of your invitation to discuss this problem as it should be discussed.

To them I wish to say, The trouble lies with *you* Your Congressman is afraid of your vote. Therefore he balks and actually delays the working out of the destiny of the greatest nation on earth It is up to *you*, you and Bill and John, to get busy and study this problem and make your wishes known And it is a glorious problem Try it!

To me the five Merchant Marine articles mentioned have been a means of evolution in my own ideas, and in view of the great importance of this problem I am offering my third letter on the subject, hoping that you may thus be led to see how easy it is to get into print in a really worthy periodical and on a gloriously patriotic subject, *and to try it for yourself.*

After careful consideration I believe that the following plan would the most effectually accomplish every desired result and meet every worthy objection

In order to get our just share of our commerce with each foreign nation, viz., one-half of it, without the payment of a single dollar in subsidies or the remission of a single dollar in duties, let us negotiate treaties with other nations for an equitable division of the carrying trade between each foreign country and our own, to the exclusion of vessels of all other foreign nations.

Thus, taking Brazil as an example, let American vessels loaded at home for Brazilian ports secure Certificates expressed in figures based upon the amount of cargo carried multiplied by the number of miles to be traveled The same vessel, if after unloading in a Brazilian port should reload with a Brazilian cargo for an American port, would receive similar Certificates from the Brazilian authorities. Both of these Certificates would then be exchanged for Receipts, the Brazilian goverament holding the Certificates and the American ship the Receipts. These papers might be entitled American-Brazilian Merchant Marine Certificates and Receipts. In exactly similar manner Brazilian vessels plying between Brazil and the United States would receive Brazilian-American Certificates which would be exchanged with the American authorities for Receipts.

The American vessel, upon its arrival home, would exchange its American-Brazilian Receipts for Brazilian-American Certificates, the latter having been obtained by our goverament as evidence of traffic carried on by Brazilian vessels in exactly the same manner as the Brazilian government obtained American-Brazilian Certificates. The exportation of the Receipts received by our government would conclude this part of the process.

On the next and succeeding trips the American vessel would go through exactly the same process except that it would be required to surrender to the Brazilian government Brazilian-American Certificates in amount corresponding to the amount of traffic in which it would be engaging on that trip Of course, Brazilian vessels would be accorded exactly similar treatment in American ports

Prohibitive duties, then, upon vessels of any other nation than the United States or Brazil and on vessels not presenting the Certificates would keep out all interference and leave the carrying trade between the United States and Brazil to be exactly divided between the vessels of the two nations. For no American vessel could profitably engage in the trade unless some Brazilian vessel had engaged in an equal amount of the carrying trade and thus produced the necessary Brazilian-American Certificates. Likewise, Brazilian vessels would depend for their profit upon the existence of American-Brazilian certificates obtainable in their home ports for use in our ports on the succeeding trip.

Similar treaties could be made with as many nations as might care to enter into them, and it would certainly not be difficult to find or create sufficient inducements to the ratifying of such treaties by any nations with which we might wish to carry on trade To me this plan seems so simple and effective and so free from all possible objections as to be worthy of a trial At any rate I hope you and Bill and John will get to work and see if you can't devise a better plan.

Hettinger, N D. N. J. NOBLE

Rainfall and Parasites

To the Editor of the SCIENTIFIC AMERICAN:

On page 391, issue of June 24th, you publish an article, "Rainfall and Parasites."

I am a veterinarian, with a penchant to investigation of subjects relating to my branches. These parasites require humidity, often ground covered with water, so go through the different stages of their complicated life-cycle, is well known and understood It is unfortunate that careful statistics are not kept in this country regarding the increased loss from this source, and we must refer to European statistics to study this problem.

Some years ago Dr. Hutchison, meat inspector at Portland, Oregon, by careful observation found out that cattle and sheep from overflow districts where carp were numerous, were free from liver flukes (*Distornum hepaticum* or *Fasciola hepatica*) The carp is a good scavenger, and destroyed the flukes during their water stage or destroyed the water snails that were the hosts, during a certain period of the *Cercariae.*

In the nineties I was in practice on the coast of Oregon, in Coos County There we suffered losses from *Distornum hepaticum*, especially after wet seasons, when the bottom lands had been under water and were used as pasture soon afterward Lungworms also killed many sheep and calves The life-cycle of *Filaria pulmonalis* is not known

After many experiments—attempts to cure the affected animals—it occurred to me that to prevent would be more rational Clean the pastures How?

Ducks, geese. A flock of ducks and geese will go over a good deal of ground, and destroy all forms of animal life. No doubt large tracts could not be "cleaned out" in this manner, but I remember two ranches on which, after two years of systematic running of ducks, the calves remained healthy, and the sheep were free from lungworms This latter fact was notoworthy, because the life-cycle of this parasite has not been worked out.

Some years ago, when at the veterinary department of the University of Pennsylvania, I mentioned these facts to Prof. C F Marshall, and he fully indorsed my statements, although he had never had opportunity to put the idea to actual test

The keeping of water fowl, especially ducks, is indicated in game reserves. Ravages of *Distornum hepaticum* among elk, moose, deer, are common, and the ponds are infested before we know the cause and the losses appear. But if some quarters are provided for ducks and swans and geese (they may be ornamental, although Indian runners are best) and their breeding favored, they will destroy many injurious forms of life that—no doubt about it—are necessary to permit a complete life-cycle of several parasites This has been worked out in the life-cycle of the flukes (water snails—*Cercariae*); observations that I made during several years led me to assume that the same means also prohibit the development of *strongylus filaria* and similar parasites (*vers pulmonalis*) in sheep and cattle and hogs.

Would you tell me from what paper of Prof. M. G. Moussu your article "Rainfall and Parasites" is a *résumé?*

At present I am on the staff of the local department of health and sanitation, and am therefore interested in rational prophylactic measures. I always read your valuable publications

Tacoma, Wash C H SCHULTZ, M D V

The Left-hand Mold-board

To the Editor of the SCIENTIFIC AMERICAN

In your issue of June 17th a patent office examiner expresses surprise at seeing so many plows in the West with left-hand mold boards

When I was a boy—I am now sixty four years old—only the right-hand mold-board was made In the last thirty or forty years, I have not seen one

The advantage of the left-hand is that the leader walks in the last furrow made, and the off or right hand horse on the unplowed ground, so both are on solid ground

As the leader is usually the larger, this is very advantageous to the off horse With the right hand mold board the off-horse had to pull on soft plowed ground

You have probably received many better explanations before this will have reached you

I have had a great deal of interesting and valuable information in the last few years from the SCIENTIFIC AMERICAN, and am glad to reciprocate in a small way

Taylorsville, Ky E D BOURNE

Niagara Falls from a New Point of View

To the Editor of the SCIENTIFIC AMERICAN

It seems that a great deal of valuable energy is being wasted in hysteria over the supposed wanton destruction of Niagara Falls

We hear great tales of woe, with heavy sob effects, ferninst the time when this beautiful cataract shall become a dribble and the wild, rugged gorge shall be but a dirty, grinding workshop where a coterie of millionaires are enabled to pile up further hoards of unearned increment, to the detriment of all "the people"

I hold that whole volumes of this kind of gush can be very easily dispensed with or turned into other channels without any injury to the body politic

It seems strange to me that in all this discussion we hear nothing whatever of the good to come to humanity from allowing this immense falls to work out its board and lodging

Here we have a force of a sum total of 5,000,000 horse-power not doing one thing but tumbling down stairs and showing off its shape (the latter being at present in bad order and going worse) But a very small part of this immense power is put to work to benefit man, while under proper management, fully two-thirds of it could be made available and the falls still left a thing of beauty and a joy forever The works now using the water seem to have their out falls on a very high level Were these at a lower level, far less water would do the same work Then look at the way the falls itself is wasting good material, there is that ugly V-shaped crotch in the "horse-shoe" where the water is now about twenty feet deep

Some aesthetic asses become very emotional over this fault, referring to it as the "great green heart" It reminds me more of a stomach, greedy and insatiable and bidding fair to soon ruin the whole show by eating back into the rock and forming a narrow sluice To this feature, more than the power houses, can be attributed the shallowness of water on the other parts My remedy is this let the State of New York and the Province of Ontario jointly build large sluice ways around the falls, their combined capacity great enough to accommodate all the water running over the falls By diverting the water to them, the edge of the falls can be built up of concrete and trimmed off to a uniform level, so that one-third of the water would at all times keep the falls falling If thought necessary the coping could be made of vanadium steel, so as to insure against any wearing away of the bed and spoiling it This would allow of an immense amount of energy to be available which would give employment to many people and furnish necessaries of life to thousands at cheaper prices than if made by using coal and that without smutting up the country with smoke In addition it would bring a good revenue to the State from the renting of water supply and it wouldn't be any more difficult than for the Panama Canal engineers to take care of the Chagres River or the Dutch engineers to keep out the Atlantic Ocean or for the Dublin police to keep the loyal Irish from setting Ireland free A strong husky man looks far better when engaged in honest toil making the world better for his existence, than when he is standing around a street corner showing off his shape and I say the same of a waterfall

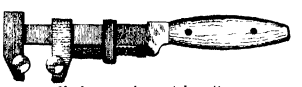
Washington, D. C. SENEX SMITH

Suggestions for the Workshop

A Simple Tube Cutter

By William Grötzinger

THE monkey wrench may be made to serve as a tube cutter by the following simple method Steel disks such as are used on the regular tube cutters are put on the jaws of the wrench These disks can be



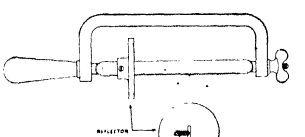
Monkey wrench as a tube cutter.

had for a few cents from any hardware store Bore a small hole through each jaw of the wrench A stove bolt is passed through each disk and tightened to the jaws of the wrench Allow a little room for the disks to turn To cut different sizes of pipe, simply adjust the jaws, as you would to fit the wrench on a nut

Using a Reflector on a Hacksaw

By H. B. Chapman

WHEN sawing sheet metal with a hacksaw and trying to saw to a line which has been scribed on the metal, the task is found very difficult unless the light is just right Recently a man in the shop where the writer is employed made a reflector for his saw so that it would throw a good light on the



A reflector on a hacksaw.

work A round disk of brass was made as shown at *A* The disk was turned so as to have a collar at the back, a slot was cut through the center of disk so that it could be slipped over the saw A 3/16 inch set screw in the collar served to hold the disk in place while in use Some white enamel was spread over the face of disk to provide a good reflecting surface

Handy Man's Medicine Chest

By W. R. Ingraham, M.D

Remedy for Slight Burns

DOES the "Handy Man" ever burn himself? Of course One of the best, most convenient remedies he can use is a solution of picric acid in water It is very satisfying and just a little gratifying to have the excessive pain of first degree burns instantly quieted First degree burns are superficial, and the nerve endings, not being destroyed as in the deeper second and third degree burns, set up a howling remonstrance in the way of pain

Picric acid of a strength 1 to 200 (about one-third teaspoonful to one pint of water) or a saturated solution is used It is antiseptic and will prevent suppuration It is analgesic and "will make it feel good" It stains yellow, but the stain comes out in the wash Keep a small vial of the acid handy When you get a burn (if skin is not broken) sprinkle a little acid in a basin of water Saturate a strip of gauze or cloth with this and bandage in place In a very little while (or as soon as the picric acid coagulates the albuminous exudate) the pain is quieted

For Deep Burns

Use picric acid as above for deeper burns (blisters and broken skin) but be more careful Pour a little alcohol in the basin to be used Roll it about so that the alcohol wets all the inside Set it on fire and every germ in that pan dies instanter Pour water that has been boiled from the tea kettle into the pan, and add the picric acid Bandage the burn with clean aseptic gauze and saturate it with the solution Blisters should be opened and contents expressed Open them with a needle, the business end of which is sterilized by holding in the flame of a match The soot will do no harm For still deeper burns or burns of large area (third degree) much can be done by the above to alleviate suffering until physician can be had but send for him at once The attending shock is serious

For Small Cuts and Abrasions

If the Handy Man cuts his finger or knocks the skin off his knuckle he should proceed as follows I Cleanse the wound Hydrogen peroxide is becoming a favorite antiseptic and with good reason Besides being a germ killer it acts and cleanses mechanically Its effervescence dislodges and carries away dirt and any foreign matter that might infect the wound Try it on a splinter of decayed wood at which you have picked and fussed in an endeavor to extract The hydrogen peroxide "boils" it right out Therefore cleanse the cut by pouring on from a bottle a little of it, full strength (A medicine dropper is convenient) II Dust on a little aristol Aristol is an iodine compound, having the useful antiseptic properties of iodoform, but lacks the disagreeable odor and irritating properties of the latter With the exudate from the wound it forms a good artificial antiseptic scab. It may be purchased in small sifting top bottles III Apply a protective dressing A bit of absorbent cotton pasted down over the wound with collodion forms a stiff protecting shield, which stays in place May be washed over with soap and water and will not require renewal for two or three days For a contused finger nail, or cut near end of finger so liable to painful knocks it forms a stiff, comfortable thimble that is soft inside, looks better than a rag and does not interfere with work

For smaller, more superficial wounds than the above a useful dressing, better than the questionable court plaster, or even adhesive tape, is collodion, to which has been added aristol or iodoform (50 grams to the ounce) A small glass rod, the ends of which have been smoother by melting with a blowpipe in an alcohol flame, makes a convenient applicator for the collodion Pass it through the cork and leave it in the bottle permanently.

For Wounds and Painful Injuries.

In case of deep wounds the collodion dressing is not applicable and the soothing properties of a moist dressing are desired *Pour a measured quart of water into* the basin to be used Gage the quantity with your eye Throw out the water and sterilize the basin (as above) by pouring a little alcohol into the basin and rolling it about to wet all the inside Set it on fire with a match and the basin is thoroughly sterilized Pour a quart of water that has been boiled directly from the teakettle into the basin One tablet bichloride of mercury (as usually prepared) makes a 1 to 2,000 solution when added to the quart of water

Sterilize another smaller basin by the method described above and pour a part of the solution into it for later use Cleanse the wound as thoroughly as conditions permit Hydrogen peroxide of full strength or diluted with water is usually sufficient If the wound is very dirty and much lacerated, as machinists' wounds are apt to be, the following method of cleaning is perhaps better

Add to 1 quart warm water in which the wound is to be washed 2 teaspoonfuls lysol (This makes about 1 per cent solution) Lysol has an odor similar to carbolic acid, but is not so poisonous It forms a soapy solution, hence its value as a cleansing agent It numbs the parts and makes them less sensitive to pain The part should now be thoroughly irrigated with the bichloride solution in the larger basin, being sure that all the lysol solution is removed from the wound

Surgically clean gauze (sterilized, aseptic) is now bandaged over the wound and moistened with the clean bichloride solution saved in the smaller basin for this purpose Bandage lightly If the gauze dries and the wound becomes painful inside of 4 hours, remove the outer plain bandage and moisten the gauze with the solution again Use weaker bichloride of mercury solution for the next and succeeding dressings (1 to 4,000). If too strong healing granulations may be retarded.

Home Made Aseptic Gauze

Plain aseptic gauze (absorbent) may be prepared at home by the following method: For each five yards of ordinary cheese cloth use one-quarter pound common washing soda to sufficient water to cover the gauze. Boil for one-half hour and rinse in several changes of water to remove the soda This process removes the fat or oil from the fabric and makes it absorbent After it has been dried it is cut into suitable sizes—strips one yard long and four inches wide are convenient. The gauze is now sterilized and packed ready for use in the following manner: Screw top jars with caps are placed in a large bread pan, and the gauze is arranged loosely in the other end of the pan Place in the oven and bake until the gauze begins to scorch slightly. Remove pan and all to a table and while hot pack the strips into the jars Use a pair of forceps or long tweezers and a short wire for this purpose. The tips of the tweezers and wire should be made sterile by passing through an alcohol flame several times, or they may be sterilized by baking with the jars and gauze.

Seal the jars and you have a good supply of aseptic gauze ready for instant use

When using the gauze it is well to remove the strips with a pair of tweezers, the tips of which have been sterilized in an alcohol flame. This avoids possibility of contaminating the gauze left in the jar. A quick, convenient alcohol flame may be had by saturating a small pledget of cotton in the mouth of a bottle

Moist bichloride gauze, which is expensive to buy, yet invaluable in case of accident, is made as follows: Prepare and pack the gauze as above Then prepare a 1 to 1,000 solution of bichloride as just explained (burning out the pan with alcohol and using boiled water) Pour this solution over the gauze in the jar until it is thoroughly saturated and allow it to stand for 24 hours. Pour off the excess and seal it air-tight. If dry bichloride gauze is desired prepare the gauze as above, dry it thoroughly in the oven and repack. However, the moist gauze is to be preferred

In using this gauze observe the precaution stated above, i. e., use weaker antiseptics after 24 hours and for subsequent dressings

Moist picric acid gauze for burns may be made and kept in a jar for immediate use as follows: Prepare and pack aseptic gauze, as above Prepare a picric acid solution in the manner described (1 to 200) and pour it over the gauze Let it stand and then pour off the excess and seal it air-tight

How to Extract Broken Watch Screws



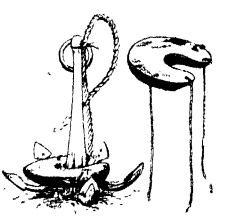
Device for removing broken screws.

SMALL screws frequently break off in clockworks, and in small machinery, and can not easily be removed A simple tool to extract the broken off screws is here shown It consists of a cramp, large enough to reach across a watch plate Provide two or three sets of 2/32-inch steel screws, with different sized hardened chisel-like points To use the tool, tighten the chisel point against the broken screw, and when you have a firm grip, turn the whole tool around, and the broken screw will invariably be drawn out

The Grapnel as a Mushroom Anchor

By Albert F. Bishop

AN ordinary grapnel can be made to give good service as an anchor by attaching to it a lead weight of U-shape, flat on the top and rounded on the bottom to fit the grapnel. This weight may be simply tied on the grapnel with cords when desired. It is not supposed to be used around a rocky or stony bottom. On a sand or soft bottom it acts like a mushroom anchor Where a small launch or boat is at anchor with a bridle it generally lies across the current or broadside to the wind This is quite important for some kinds of fishing, and it is always necessary to use heavier anchors or grapnels when in this position The lead weight is



Weighted Grapnel as a mushroom anchor.

easily cast in sand by taking a bent piece of tin and scooping out the sand to the shape desired It is not necessary to make a pattern The weight should be roughly about fifteen pounds for a ten-pound grapnel The rope is spliced in a ring at the bottom of the grapnel, brought up to the top and seized with a small cord to the ring or eye. Two turns of ordinary cord are generally enough for the seizing, which is called the trip cord.

Abstracts from Current Periodicals

Phases of Science as Other Editors See Them

The Production of Anthracite Coal in 1910

THE United States Geological Survey has issued an advance chapter from "Mineral Resources of the United States" for 1910, in which Mr. Edward W. Parker gives the following interesting statistics:

With the exception of the "boom" year, 1907, the production of anthracite in Pennsylvania in 1910 was the largest in the history of the industry. The quantity produced in 1910 was 75,433,246 long tons, an increase over 1909 of 3,048,997 long tons, or 4 per cent. The value increased from $149,181,587 in 1909 to $160,276,302, a gain of $11,094,713, or 7.4 per cent. The production in 1910 was within almost exactly 1,000,000 long tons of the maximum record for 1907, when the output amounted to 76,432,421 long tons. The value of the product in 1907 exceeded that of 1910 by $3,308,754. The average price per ton at the mines in 1910 was $2.12, against $2.06 in 1909, $2.13 in 1908, and $2.14 in 1907.

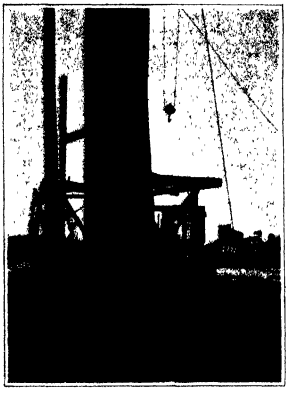
Of the total production in 1910, 65,735,024 long tons, or 87.1 per cent, were loaded at the mines for shipment to distant points, 1,804,082 tons, or 2.4 per cent, were sold to local trade and employees, and 4,894,140 tons, or 10.5 per cent, were consumed in the operation of the mines. In former years the colliery consumption was not considered as having any market value, consisting as it did of screenings, or culm, which unless so used was wasted. More recently through the invention of grates and furnaces adapted to the use of small sizes of anthracite, stimulated by the higher prices of the prepared sizes, the percentage of waste has been reduced to a minimum. "Buckwheat," "rice," "barley," and even culm are now important steam raising fuels, particularly in hotels, apartment houses, and large office buildings in the larger cities of the East, where smoke-inhibiting ordinances are in force. In fact, these small sizes are now the only grades of anthracite used to any extent for this purpose, and are the only sizes that will compete with bituminous coal for steam raising in the eastern markets. An object lesson in practical conservation is here furnished and, to the credit of the operators in the anthracite region be it said, it was put into effect a number of years before the agitation over the conservation of natural resources began. Not only are the small sizes produced in the present mining operations sold and utilized but the unsightly culm banks which blotted the landscape in the anthracite region are fast disappearing as the usable coal is being recovered from them by washeries. The prices for buckwheat at New York Harbor in 1910 ranged from $2.20 to $2.50 per long ton, rice ranged from $1.65 to $2, and barley from $1.35 to $1.50. With 65 per cent of the tidewater price representing the value at the mines, the prices for these sizes f. o. b. cars at mines were: Buckwheat, $1.43 to $1.63; rice, $1.07 to $1.30; and barley, 88 cents to 98 cents. The culm used at the mines is valued at 25 to 50 cents a ton.

Of the total production of 75,433,246 long tons in 1910, 4,184,629 tons were recovered from the old culm banks by washeries, and 81,833 tons were recovered by dredges from the bed of the Susquehanna River. The total output from the mines was 71,156,784 long tons. In 1909 the mine production was 67,945,137 long tons.

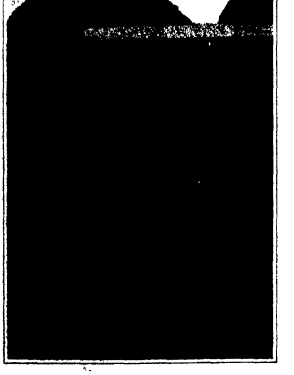
Preserving Poles

FOREST SERVICE BULLETIN 84, entitled "Preservative Treatment of Poles," contains a large amount of well-arranged information which should prove interesting, not only to many general readers, but especially to the users of telephone and telegraph poles. In the publication are summed up all the excellent results achieved by a number of experts of the Forest Service in their effort to treat poles with certain preservatives in order to increase their durability. In 55 pages of text are given the results of the co-operative experiments aiming to simplify commercial pole-treating practice by the use of the latest approved methods. The scheme of the *Bulletin* may be outlined briefly as follows: General principles of wood preservatives, results of seasoning tests; brush method of treating poles, open tank process of treating poles; results of treatment by species; design and operation of pole-treating plants; increased life afforded by preservative treatment; and financial saving. The last two chapters are of high practical interest and value to large pole using concerns whose experience warrants them in employing means for impregnating the portion of their poles most subject to decay—the butt. It is brought out that the cost of the treatment varies greatly according to the methods employed and the quantity of preservatives used, but the results are correspondingly very much better for the more thorough treatments.

Mr. O. T. Swan whose results of more recent experiments are included in this bulletin, devised the first really practical open tank method of treating the butt ends of poles. He greatly advanced the efficiency and compiled very important data which he uses to show that a great saving is possible and that plants for butt treatments may be constructed in a simple and inexpensive manner. Mr. Swan built his own design for steeping the poles and this has proved so successful that an illustration of the tank now in use is given here. The poles are treated by dipping them in a tank containing the preservative fluid by standing them in an open tank and securing an absorption of the preservative by periods of heating and cooling. Photograph of a cross section near the lower end of the poles



Experimental open tank treating plant showing successful type of pole holding frame work.



Western yellow pine cut off at the ground line showing penetration at this point by the open tank method.

is also given to show the penetration of the creosote oil.

Mr. Swan is well known in the world of scientific and practical wood preservation, and the results he achieved are sure to meet a cordial welcome among creosoting concerns. His figures show painstaking thoroughness and accuracy which gives them technical and economic value.

Spruce Yarn

THE expression "mahogany overcoat" used to be employed as a sort of synonym or euphemism for coffin, but if things keep on as they have started under the impulse of inventive genius, we may soon hear of "locust shirts" and "bass wood collars" and even "long leaf pine ulsters." The Germans have long since endeavored to make themselves independent of foreign sources for the various raw materials which they require for their own home consumption, as well as to manufacture for export, and now we hear that there has been made of spruce wood a yarn that is quite spinnable. Whether this is a "yarn" or not, cannot be said but on the authority of *Der Holzhaufer*, which is many times removed from being a comic paper, and in fact revels in the most wooden of statistics for the foresters and lumber dealers of Germany, the formidably named "Aktiengesellschaft fur Garnfabrikation" of Berlin has for some time been having experiments made on the same lines as those which have resulted in the production of artificial silk and cotton; and the result seems to be gratifying, as spruce is comparatively plenty in the Fatherland, while as yet (there being no Luther Burbank on her toilet) cotton and silk are not numbered among the productions of central Europe. The new product is said to have a fine finish and much better surface than is usual with the natural fibers as yet used for spinning. The Technische Laboratorium fur Materialprufungen of the Technical School for Textile Industries in Reutlingen has shown that when leather feed rolls are used the new yarn when used as warp or chains is 124 times as strong as jute, and when used as woof or fillings, 30 times as strong. As against jute "sylvalin" has the very great advantage of being odorless, even when moist. Articles woven therefrom are naturally not exposed to the attacks of moths. If all these things are true, and the process is not too expensive there must be a good future for the new yarn, especially if (as is said) it can be worked with all the usual other fibers. The first attempts at weaving have been with wall tapestry which are most satisfactory in pattern and color, and have the great advantage of being so smooth that dust does not attach itself thereto as readily as to other stuffs used for the same purpose; also, that in brushing them down they do not get rough. So-called Japanese mats have been made of sylvalin and are hardly to be distinguished from those made of rushes. There is this great advantage on the side of the sylvalin yarn, that it may be woven in the loom, whereas by reason of the shortness of the individual pieces, rushes can be worked up only by hand. The new material has also been made up into cord of various kinds, alone and in combination with other materials, for decorative and other purposes.

One Hundred and Seventy-one Dead Horses a Day

WHILE the hot period of July in New York was more severe than usual, the deaths of work horses due to the heat during those six days is a very strong argument in favor of the electric commercial wagon.

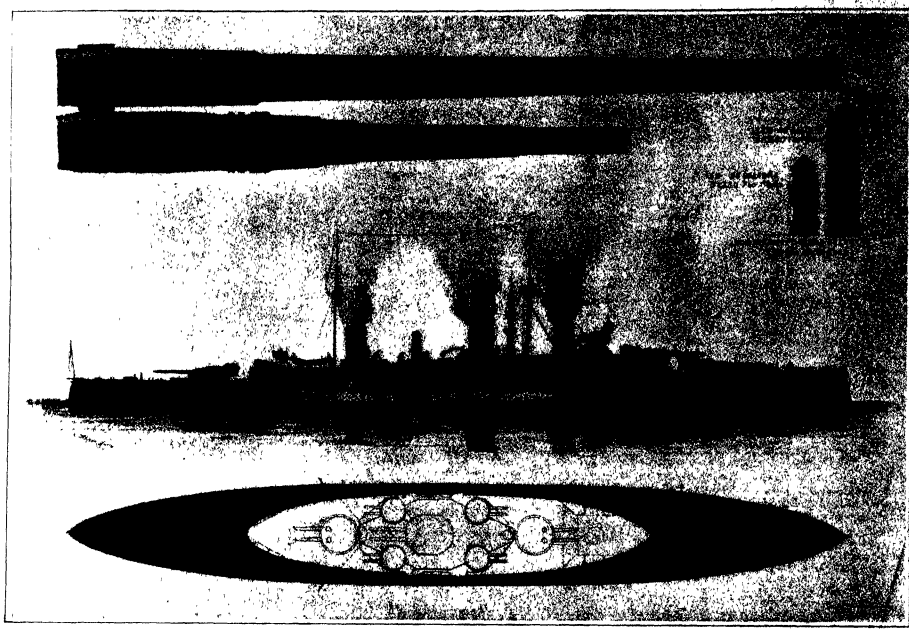
The health department of New York city, which has the task of removing dead horses, reported that during the six working days of the hot period 171 horses died each day—a total of 1,026.

These horses represented over half a million dollars cash value, which was entirely wiped out in a single week.

In addition to this the horses not affected fatally were able to work at scarcely half their normal capacity, and fully 25 per cent of the drivers time was consumed in staving off sun stroke by frequent applications of water and frequent rests in the shade.

It is estimated that the money represented by the horses which died would pay for a sufficient number of electric vehicles to do all of the work done by the horses, and do it more efficiently and economically.

In New York city where it is estimated that there are in the neighborhood of fifty thousand draft horses not less than four per cent die annually from the effect of heat in summer and slippery pavements in winter. This million-dollar annual loss is in addition to the normal deaths, and represents a tremendous increase in the cost of horse haulage.



The 700-foot dreadnought "Lion" of 1912 is here compared on the same scale with the "Oregon" of half her length, built nearly twenty years earlier. Note the high freeboard, and the lofty elevation at which the guns are now carried.

TWENTY YEARS' GROWTH OF THE ARMORED SHIP

The New British Dreadnoughts

How the New 13.5-inch Gun is Mounted on the American Center-line Plan

THE accompanying illustrations represent the same ships of the new British warships of the 'Orion' and 'Lion' types which will commence their trials in the fall. The main points of interest in these vessels are that they are the first British ships of the dreadnought class to carry all their guns on the center line (which are of the new 13.5-inch model) and that the battleship-cruiser "Lion" is of a greater tonnage than her contemporary battleship the "Orion."

A deck plan view of the "Orion" class was given in our issue of the 27th of May together with an article on the center line disposition of guns. The points need not be recapitulated here, excepting that the further reasons given in England for the new arrangement of the main battery are (1) that the greater tonnage of the 13.5-inch prohibited so large a weight being placed on the beam (as the 12-inch were in previous British battleships) and (2) that of the *en echelon* or diagonal placing of the guns was unsatisfactory. Theoretically the *en echelon* disposition should have enabled all the guns to bear on either broadside, but in practice it was found that the designed arcs of fire had to be cut down to prevent one barbette firing into or damaging the other by blast.

The "Orion" carries ten 13.5-inch 45 caliber guns on a displacement of 22,680 tons, together with an "anti torpedo" battery of 20 4-inch quick-firers. The 13.5-inch weapons are disposed in a similar manner to the 14-inch of the "New York"; i. e., the second pair forward fire over the first, and the fourth over the fifth aft. The third pair is placed on the same level as the fifth, but the British ship cannot fire her fourth pair over so wide an arc or so far forward as the "New York" on account of the superstructure between the third and fourth positions, which does not exist in our ship. The 13.5-inch in the "Orion" (and also in the "Lion") are of a very powerful type, weighing 87 tons and firing a projectile of 1,250 pounds with a muzzle velocity of 2,821 foot-seconds, developing an energy of about 69,000 foot-tons. The penetration is 25½ inches of Krupp N. C armor at 3,000 yards, the rate of fire is the same as that of the 12-inch viz. 2 rounds in 90 seconds.

The "anti-torpedo" armament consists of 20-4-inch quick-firing guns as in previous dreadnought ships. The British admiralty apparently seem satisfied with this type of gun in spite of the employment of larger guns for this purpose abroad. They consider that the higher command of the smaller guns puts them on an equality with 5-inch or 6-inch weapons carried in a main battery. These guns, when not in use, disappear into armored shelters, a lesson evidently from the impotence of the Russian ships after the battle of Tsushima to destroy the attacking Japanese torpedo boats, owing to the wrecking of the exposed light quick-firing guns by the abnormally high-explosive shells used by the Japanese. These guns are no longer mounted on the barbette tops, but are distributed at two levels in the superstructures, and are so arranged as to bring a good proportion to bear ahead and astern, as it is from these points torpedo attack is mostly to be feared. Four submerged torpedo tubes are fitted, the torpedo rooms being inclosed in thick armor. The provision for boat stowage is of a novel type, the boats being placed between the tripod mast and the aft funnel and protected by the low blast screen seen in the illustration which conceals them. This is a remedy for the damage incurred by the boats in previous gun trials of British dreadnoughts by the concussion from the discharge of the big guns.

The dimensions of the "Orion" are 545 feet (length) by 88½ feet (beam) by 27½ feet (draught), and with 27,000 horse-power and Parsons turbines the estimated speed is 21-22 knots; the coal supply is normally 900 tons but capacity is provided for a maximum of 2,700 tons together with 1,000 tons of oil fuel. Four propellers and double rudders are used. The protection to the water line is 12 inches amidships, thinning to 2½ inches forward and aft; over this there is a belt of armor (extending to the extreme bulkheads) of 12 inches. The gun positions are understood to be 11 inches thick, the hoods being 12.8 inches thick, while stability is insured by a protected deck of 2½ inches under which are four unpierced bulkheads dividing the ship into five watertight compartments. The special internal protection against torpedo attack is of a secret nature.

The "Lion," which represents the latest development of the battleship-cruiser, is of 25,250 tons and has the enormous propulsive power of 70,000 horse-power; her designed speed is 28 knots; it is, however, confidently expected that she will attain 30 knots on her trials. For this speed a hull of fine form and great length (to accommodate the boilers and engines) is essential. The dimensions are: 700 feet (length between perpendiculars), 88½ feet (beam), 27½ feet (draught). The three enormous funnels are surrounded by steel screens to protect them from the blast of the guns; these also give protection to the boats as in the "Orion"; further accommodation for boats is made on the superstructure aft of the "wireless" pole-mast. Except for this and the low erection round the conning tower, the hull is devoid of the usual excrescences so liable to wreckage by high explosive shells. The guns are of the 13.5-inch pattern, eight being mounted, but in a different manner from the eight of the "Michigan." The second pair forward fire over the first, the third and center barbette is placed between the second and third funnels and the fourth by itself aft; all the guns fire on the broadside, four ahead and two astern. The new system of fire-control is installed in this ship (and also in the "Orion") whereby the guns can be trained in unison or independently by supplementary electric motors controlled from the range-finding position on the tripod mast. A reserve armored control-station is placed between decks; also, fire-controls are fitted to the 4-inch quick-firing guns. The searchlights are mounted on the bridge forward and on top of the blast screens.

The motive power is supplied by 42 Babcock & Wilcox boilers and Parsons turbines, the maximum fuel

(Continued on page 295.)

The Creation of "Artificial Life"

The Making of Living Matter from Non-living

By Benjamin C. Gruenberg

FROM time to time we are informed that the Riddle of the Universe has been solved by the artificial production of "life" from non-living materials. But each time we wondered how it was done, for a few days, and then find out that it wasn't done at all. The riddle is still there. The expression "artificial life" has been used in recent years for two entirely different sets of ideas.

On the one hand is the attempt to make artificial combinations of matter behave like living protoplasm—that is, to make live matter out of the non-living materials lying all about us. On the other hand is the attempt to make the eggs of various animals develop without the co-operation of the sperm—or to produce "artificial parthenogenesis," as it has been called. Both kinds of experiments are calculated to throw much light on the fundamental nature of "life;" but they differ considerably in their methods as well as in the point of view that prompts them. We shall discuss first what has been done toward the making of "artificial life" in the cruder sense.

The problem of artificial life is connected intimately with that of the *origin* of life, and also with that of the *characteristics* or distinctive properties of living matter.

From earliest times there has persisted the idea that plants or animals may arise "spontaneously" from non-living matter, notwithstanding the common experience of mankind that wherever the origin of a living thing could actually be observed, it was seen to arise from another living thing. This widespread belief in "spontaneous generation" no doubt owed its tenacity to the fact that in many cases the continuity between generations could not be directly observed. For example Eggs of eels had never been seen until within our own times; maggots were known to develop in putrifying meat, but no one had seen the flies deposit their eggs in the meat, the presence of tape-worms and other parasites within the bodies of human beings and other animals; the presence of insects within the "galls" of plants, without any apparent means of entrance—all these facts served to perpetuate the idea that life can, and regularly does, arise spontaneously. The idea that all organisms arise from pre-existing organisms is a comparatively modern one; and it was accepted on philosophical grounds long before there was any actual demonstration of the principle. From the nature of the case, however, the principle *omne vivum e vivo* cannot be proven, since it involves a negative. It is equivalent to the statement that living matter does *not* arise from non-living matter. In the seventeenth century Francisco Redi, a physician of Florence, showed that by preventing the access of insects to meat, no grubs or maggots could be formed in it, no matter how much it putrefied. In opposition to these experiments, a Scotch clergyman named Needham attempted in the middle of the following century to show by means of experiments that "wheat-eels" and other animals do arise spontaneously. He showed incidentally that tiny animalcules appeared in extracts of vegetable matter, on long standing, even after these had been boiled. But his contemporary, the Italian monk Spallanzani, showed that if the decoctions were thoroughly boiled and closed against the entrance of dust, there would be no appearance of life. Although Spallanzani's experiments were not beyond criticism, his countless tests in harmony with these, served to practically all biologists to-day—namely, that all existing plants and animals have originated from others of essentially the same kind.

But although the notion of "spontaneous generation" has been thus abandoned by all scientific thinkers in modern times, the question of the origin of life took on a new interest with the spread of evolutionary thought during the latter part of the nineteenth century. Darwin did not attempt to answer this question. He took for granted the origin of life, in some simple form, as the beginning of that evolution to higher forms which he attempted to explain with his theory of natural selection.

Apart from the theory of special creation for each species, there is only one opinion possible as to the origin of life, and that is that at some time in the past non-living material passed into a living condition—in other words, that life did originate spontaneously!" This notion of spontaneous origin of life must not be confused with the older notion of the spontaneous generation of plants and animals of all degrees of complexity.

Alfred Russell Wallace and others think it necessary to assume that the origin of life from non-living matter was brought about by the interposition of some spiritual or divine influence, of the nature of which we know nothing. Charlton Bastian and another school of biologists think that the transition of non-living matter into the living state has taken place continually from the first and is taking place now. But most biologists accept the view that living matter originated from non-living in the very remote past, and that all living things now existing are derived by a succession of generations from the primitive origins.

The Swedish physicist Arrhenius and the Englishman Lord Kelvin are strong advocates of the view that life upon this earth was developed from primitive "germs" that were brought here in the remote past "upon the wings of light" or upon some meteorites, through lifeless space. It has been pointed out a number of times that this account of the origin of life simply shifts to some other planet or system the theater of the origin, without giving us any suggestion as to the manner of the origin.

The requirements of any evolution theory are met by the assumption that life originated "spontaneously" from non-living matter at some time in the history of this planet or of the universe. But to know whether such an assumption is warranted we should know more about the characteristics of living matter, especially in its relation to non-living matter. Until comparatively recent times the processes going on in living plants and animals had been so little studied that the idea of life being dependent upon external conditions was entertained by very few men. With the development of modern physics and chemistry, and with the application of the methods as well as of the results of these sciences to the study of living things this idea rapidly spread, until it is now pretty generally accepted. Moreover the strong tendency during the past two generations to unify all knowledge, and to extend the principles of one science to the problems of all others, have stimulated the search for the physical and chemical foundations for "vital" processes.

Of all the lines of research thus developed, only three need here be discussed.

The word "protoplasm" had a varied career for about twenty years, but about fifty years ago it began to be definitely applied to "the physical basis of life" or the substance found in the cells of all plants and all animals. We know a great deal about this or what substance or rather combination of substances, but there is still a great deal more that we do not know. There have been many opinions as to the structure of this living matter that it is fibrilla that it is like a net work, that it is a mass

(Continued on page 236)

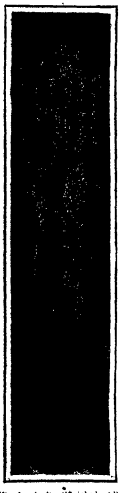


Fig. 1.—An "artificial plant" which was produced in a test-tube.

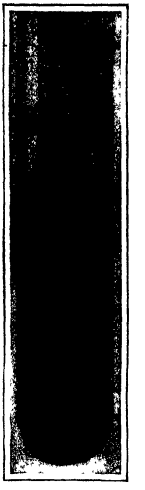


Fig. 1a.—Artificial organs showing mushroom shape.

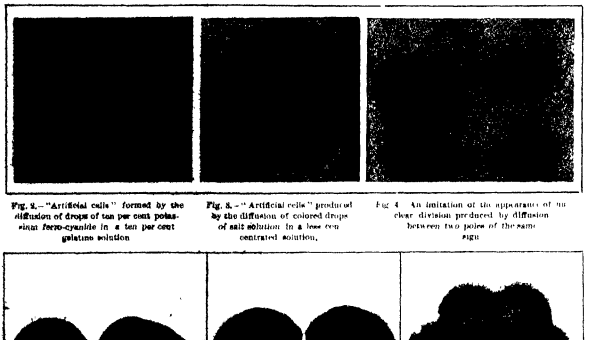


Fig. 2.—"Artificial cells" formed by the diffusion of drops of ten per cent potassium ferro-cyanide in a ten per cent gelatine solution.

Fig. 3.—"Artificial cells" produced by the diffusion of colored drops of salt solution in a less concentrated solution.

Fig. 4.—An imitation of the appearance of nuclear division produced by diffusion between two drops of the same sign.

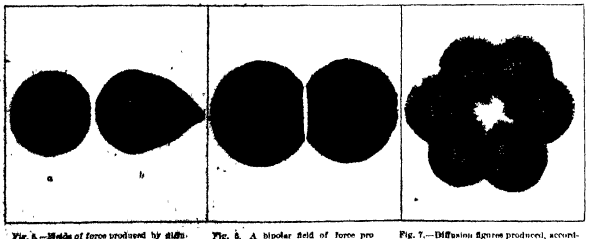


Fig. 5.—Fields of force produced by diffusion. (a).—Monopolar, produced by a drop of blood in salt solution of higher concentration. (b).—Bipolar produced by a drop of blood and a grain of salt.

Fig. 6.—A bipolar field of force produced, according to the methods of Prof. Stéphane Leduc, by diffusion between two drops of blood in a salt solution of higher concentration.

Fig. 7.—Diffusion figures produced, according to the method of Prof. Stéphane Leduc, by drops of India ink in a solution of potassium nitrate.

EXAMPLES OF SO-CALLED "ARTIFICIAL LIFE"

The Inventor's Department

Simple Patent Law: Patent Office News: Inventions New and Interesting

The Cuntz Ocean Telephone Electric Cable

SINCE the first message was sent under the Atlantic, there has been but little change in the cable itself. The copper conductor has been enlarged and there have been improvements in manufacture, but in its essential features the latest trans-Atlantic cable is only an enlarged copy of the one by which the farsightedness and energy of Cyrus Field first joined Europe and America.

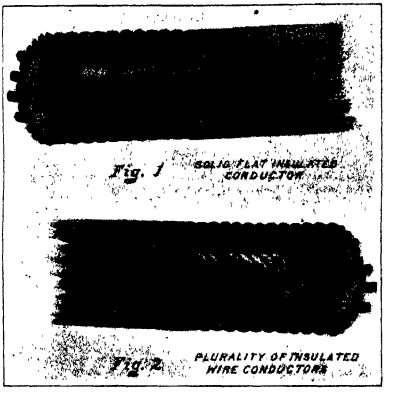
The sending and receiving apparatus at the shore ends of the cable has been improved more rapidly. By means of an artificial cable, having the same electrical properties as the real one, duplex working, or the sending of messages in both directions at the same time has been made possible, and the transmitting and receiving instruments have been made more accurate and sensitive. As the result of these changes there has been a gradual increase in the speed of transmission until now, under favorable circumstances, about forty or fifty words a minute can be sent in each direction.

But the limit of improvement appears to be reached unless the cable itself is radically changed. The cause of the slowness of submarine telegraphy as compared with that on overhead land lines is what the electricians call the "electrostatic capacity." On account of this, when an electric current is sent into the cable it must charge the whole length of the cable before its effect will be felt at the far end. A great deal of the current is used in charging the cable, and if the "makes" and "breaks" of the sending key follow too quickly upon each other, or if the direction of the current is changed too rapidly, the flow will be retarded and choked, so that no signals at all will reach the receiving end.

A rough analogy will make this action clearer. Imagine a long rubber tube with very flexible walls, through which water is to be pumped. When the water is pumped in, before any of it reaches the far end, a great deal of it will be used in distending the tube, and it will take some time for any of it to reach the distant extremity. Even when the tube is full, and the attempt is made to work the pump at the transmitting end back and forth the water pumped into the tube and drawn out of it will be used largely, if not entirely, in increasing and diminishing the pressure on the walls of the tube, and if the pump is worked fast enough, no effect whatever will be felt at the receiving end.

In order to get rapid action we must stiffen up the tube. If this is done, and its walls are made absolutely unyielding, any change in pressure applied to the water at one end will be almost instantaneously felt at the other end.

Now, returning to our ocean cable, if we can find some means of "stiffening" it electrically we can counteract the effect of the electrostatic capacity and enable the current to flow without retardation, and the signals to be sent clearly and quickly. A contribution toward the solution of this problem comes to us in the invention of J. H. Cuntz of Hoboken, N. J., which has recently been made public. The electrical analogy of the stiffening we put into the rubber tube is called "inductance," or "self-induction." Inductance has effects opposite to electrostatic capacity and when properly placed and proportioned can counteract it to any degree desired. As the capacity is distributed throughout the length of the cable, the best disposition of the inductance is to distribute it also throughout the cable. The problem has been to do this in a practical, commercial way, but it may now be regarded as solved. The chief sources of inductance are coils of wires, and if these coils have iron cores, their inductance is greatly increased. What has now been done is to wind the copper conductor of the cable in a long open coil about a thin central core, and thus make the entire cable a source of inductance, so overcoming the effects of the capacity and at one stroke increasing the speed of signaling ten, twenty or even fifty-fold.



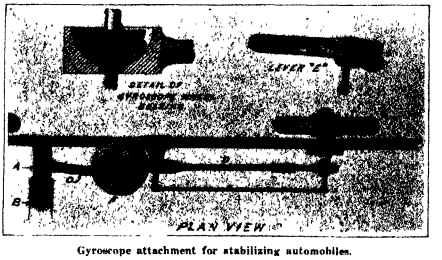
A new design of submarine cable with distributed inductance to counteract capacity and render possible rapid transmission.

What has been said about telegraphy applies with even greater force to telephony. Here the minute currents caused by the vibrating diaphragm of the transmitter vary at the rate of hundreds and even thousands of alternations a second, and in an ordinary ocean cable they would be choked up and obliterated after going a few miles. In underground cables the effects of capacity are also very troublesome, and telephony has been greatly hampered on this account. But a method was devised a few years ago (by Prof. Pupin of Columbia University) which has been very helpful in underground telephony, as well as on long overhead lines. By this plan inductance coils are placed at intervals along the cable so as to approximate the effects of uniformly distributed inductance.

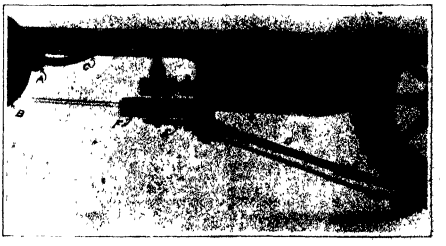
For long-distance submarine work, however, such coils would be impractical. They make bumps and introduce mechanical weaknesses which would cause difficulty and danger in laying a deep sea cable, and would increase the cost of maintenance and repair probably to a prohibitive degree.

The new cable, which has just been patented by Mr. Cuntz, avoids these difficulties and is conspicuous for its strong and compact mechanical design, in addition to its efficient electrical properties. As its process of manufacture becomes systematized, it will be made at a cost little, if any, in excess of that of the present cables, and it can be laid and maintained with no greater expense. Its use will vastly increase the speed of submarine telegraphy, and will have a most marked influence in lowering cable tolls. At the same time it brings us at last to a realization of the long-cherished dream of ocean telephony.

Think what it would mean to have Washington in telephone communication with Panama, and business men in New York and London within talking reach of each other.



Gyroscope attachment for stabilizing automobiles.



View showing the normal position of the trailing wheel.

A Gyroscopic Stabilizer for Automobiles

A RECENT newspaper article contains an interesting account of a test made on a slippery surface to demonstrate the effectiveness of a gyroscopic attachment for preventing automobiles from skidding. The attachment is described as being made under Rutt patents. This probably refers to an English patent, No. 12,842, of 1906, granted to Alfred Rutt of London. In this English patent the gyroscopic principle causes a pivoted trailing lever to oppose any swerving or skidding motion of the vehicle. In operation, the rotation of a friction wheel *A*, driven by the fly wheel *B*, is transmitted by a flexible shaft *C*, to a spindle on which the gyroscope wheel *F*, is fast. When the car tends to skid, the lateral displacement resulting therefrom, causes the trailing rod *D*, by the friction of its trailing wheel on the ground surface, to assume an angular position and so swing a lever *E*, which carries the gyroscope wheel *F*. This tilts the gyroscope wheel from its normal plane of rotation and produces the combative force directed laterally against the frame of the vehicle in opposition to the side slip and operates to maintain or immediately restore the equilibrium of the vehicle.

The gyroscopic principle has been suggested as a means of securing stability and persistence of direction in various forms of vehicles. It will be recalled that a small gyroscope is provided within the shell of some forms of dirigible torpedoes to aid in holding the torpedo on its course. In 1877 a patent was issued in the United States for an aerial machine which embodied gyroscopic wheels, one with a normally horizontal axis and the other with a normally vertical axis for the purpose of preserving the equilibrium of the machine and preventing its upsetting. In 1888 C. Benz of Mannheim, Baden, Germany, secured a United States patent for a self-propelling vehicle in which he supports the fly wheel on a vertical axis whereby it will revolve in a horizontal plane so that "the vehicle is not only easily controlled but also the greatest safety is attained against capsizing."

Other instances in which the gyroscopic principle is utilized in an effort to secure stability in automobiles, will be found in numerous United States patents including Nos. 564,127; 637,750; 653,364; 734,283; 859,293, and 907,907, to which the attention of those especially interested in the subject is directed.

Medical Compounds from a Patentable Standpoint

AT one time, new medicinal mixtures of substances of previously recognized medicinal virtue, were regarded as patentable. In recent years, however, this view has been considerably modified by decisions such as that of Assistant Commissioner Fisher, rendered May 29th, 1890,

in the case of Crippen, in which a medicinal mixture was held to be

"wanting in patentability because it covered nothing more than such a compound of medicinal agents as could be made by the exercise of the skill of a physician."

The doctrine of this decision has been followed by the Patent Office tribunals, including the Board of Examiners-in-Chief (whose decisions are not published), and is generally applied to medical compounds which are made up of ingredients known as medicinal of which any physician is expected to make such selection as his judgment may dictate for the treatment of any case he may have in mind.

Darlington's Personal Property on page 227 says:

"It is doubtful if a mere prescription forming the body of a so-called 'patent medicine' (more properly a proprietary remedy, since they are usually not patented) really exhibits invention; for no matter how good and efficient (many are very good) it is still a question whether (other conditions being disregarded) where the result of medical education has brought in a formula for the cure of disease there is anything beyond technical skill."

Some substances not previously used in medicine may give patentability in mixtures in which they are employed. It must not be thought, however, that this is a conclusive test of patentability as it must be considered whether the new ingredient is essential and material in its effect on the mixture, also whether the mixture is a true combination or only an aggregation, for many medicinal mixtures are not patentable, because the mixture possesses no demonstrable effect other than that which would result from the ingredients taken separately

Apart from medical compounds, processes of treatment have been held unpatentable. In the case of Brinkerhoff, decided July 5th, 1883, Mss vol. 24, pp. 349, Commissioner Marble says.

"The methods or modes of treatment of physicians of certain diseases are not patentable; they are discoveries which may in a majority of cases under certain conditions accomplish certain results, but no particular method or mode of treatment under all circumstances and in all cases will produce upon all persons the same result, and hence to grant a patent for a particular method of treatment would have a tendency to deceive the public by leading it to believe that the method thereby described would produce the desired result in all cases"

The Court in Morton v New York Eye Infirmary, Fisher, vol. 11, page 320, held.

"The application of ether to surgical purposes was an effect produced by old agents operating by old means upon old subjects The effect alone was new, and was a mere discovery, which, however novel and important, is not patentable,"

and suggested that the patent law is

"inadequate to the protection of every discovery by securing its exclusive control to the explorer to whose eye it may be first disclosed."

and

"Neither the natural functions of an animal upon which, or through which, a new force or principle may be designed to operate, nor any of the useful purposes to which it may be applied, can form any essential parts of a patentable combination with it, however they may illustrate and establish its usefulness"

As nearly as can be easily determined, about nine patents were granted during the past year for medical compounds.

Medical compounds, however, must not be confounded with chemical compounds, since definite individual chemical compounds are, if new, patentable, whether intended for medicinal use or for some other purpose

A Puncture Proof Tire

ACCORDING to Consul James E. Dunning, Havre, France, Mr. George Longuemare of Havre has patented and put into practical use an invention for preventing punctures in pneumatic tires which he calls "a puncture-proof metal band for pneumatic tires." The chief features of the invention are:

A band of canvas covered with small hexagonal metallic disks. These disks are arranged to fit closely one against another, and are riveted to this canvas so as to form a flexible armor.

The band of canvas thus prepared is placed in a sheath of rubber. In order to safeguard the tire, this sheath is placed between the air-tube and the outer cover. The air-chamber cannot be punctured, and even cuts in the outer cover are in no way harmful. Experiments have shown that there is considerably less heating of the tire, and that resilience is the same.

Different experiments are said to have been made before responsible witnesses to prove that nails, broken glass, etc., cannot cause punctures when the air-chamber is thus protected, and the results are reported to the Consul to have been entirely in favor of the invention.

For example, two one-inch nails were driven into the outer cover and the automobile, with four passengers, was driven five miles before further examination was made. Then the tire was removed and it was found that the air-chamber had not been touched by the nails and that even the armored device had not suffered, the nails having met the quite imperforable steel disks.

Notes for Inventors

Honors to Theodore Timby.—On August 10th, Senator Clapp of Minnesota introduced in the U. S. Senate a joint resolution directing the Secretary of the Navy to commission a warship to convey the remains of Theodore Ruggles Timby from Brooklyn to Washington, D. C., on October 12th, 1911, for burial The resolution recites that Timby, an American citizen, conceived the idea of and invented the revolving turret which was afterwards adopted by John Ericsson in the construction of the Monitor, and which made that vessel so effective in battle, and that his native State, New York, by a concurrent resolution, on May 2nd, 1890, regarded it as "a fitting if not an imperative duty of Congress to do ample justice in the premises and vindicate the genius that contributed so largely to rescuing the country from a grave peril." The resolution also recites that the Patriotic Association of America, the Monitor Association of Naval Veterans, and Naval Post 516 of the Grand Army of the Republic, appreciating the service rendered by Timby, are preparing, at their expense, to bury his remains in his family cemetery plot in Washington and they wish the commission of a warship be commissioned to convey the remains as a tribute of respect to his memory It appears from the resolution that while the remains of Timby remain in the receiving vault of a cemetery in the city of Brooklyn unhonored and neglected, the construction of the Monitor brought John Ericsson fame and wealth and such distinguished honor that our Government, as a tribute to his memory, sent his body to Sweden, his native country, for final interment After considerable discussion, the House Committee on Naval Affairs decided against recommending the adoption of the resolution, thus sustaining the position of Assistant Secretary of the Navy Winthrop, who thought it improper to thus give any basis for a claim on Congress for an appropriation in consideration of the services of Mr. Timby.

A New Kind of a Spinning Top.—An attractive spinning top is the subject of a patent, No. 999,839, to James R. Myers of Fairmont, W. Va., and has a disk and a tubular spindle molded integrally of glass. Translucent color circles are provided on the upper surface of the disk and a pin can be inserted in the spindle for spinning the top.

A Coating Machine.—A machine for coating articles is shown in a patent, No 999,789, as the invention of Alfred R. Hussey of Harvard, Mass. There is provided a revolving form for the article to be coated and this is revolved in front of a number of stomizing nozzles which direct the spray against the sides and at a downward inclination against the top of the article, means being provided for supplying the coating liquid and air and for controlling the air supply.

A Reinforced Railroad Tie.—William D. Forsyth of Youngstown, Ohio, has patented No. 999,771, a reinforced railroad tie, having a rail fastening device, including a flanged sleeve, embedded in the concrete to receive and retain a non-metallic resilient bushing and thus bushing is adapted to receive and retain an adjustable metallic split sleeve.

An Edison Storage Battery Patent.—Edison Storage Battery Company, West Orange, N J., is patentee No. 999,762, as assignee of Thomas A Edison, of a storage battery and process of treating same in which the process consists in soaking the pockets carrying the active material in a solution of bismuth tri-chlorid in acetone The active material for the negative electrode of the battery comprises electrolytically active finely divided iron, and bismuth intimately associated with the active particles

Listening to the "Innards" of an Automobile.—Leonard B Gaylor of Stamford, Conn., has taken out a patent, No 999,496, for a device for locating the defectively operating parts in automobile motors and other mechanism and including a hollow ear piece and diaphragm casing, open at both sides, and a rigid test rod, the unconnected end of which is made of non-combustible material Gaylor seems to have invented an improved stethoscope for automobile use

A Concrete Railway Tie.—A railway tie with a concrete body and a core-reinforce in the form of an I-beam, enveloped in the body, is shown in a patent, No 999,449, to Joseph J Harrell of Chicago

Matches from Grass and Straw.—A London paper tells of a process, said to be in the experimental stage, for manufacturing a wood substitute from dried grass or straw, which is primarily intended for use in the manufacture of matches At the conclusion of the process, which is described as including crushing and stripping the straw and compressing a flat layer between sheets of paper and subsequently molding the splints, the latter are cut to length and dipped in the match composition When the scarcity of wood renders desirable the use of a substitute in match making in this country, a fruitful field will be opened to inventors

A Novel Concrete Pile.—Two patents, Nos 999,440 and 999,441, have been issued to Richard J Beall, Jr., of Washington, D C The applications for these patents were filed in April, 1904 The patents relate to concrete piling, in which a tube, whose bore is unobstructed, has an enlarged separable point closing its lower end and when the point and tube are driven into the ground to the extent desired, the tube is withdrawn without the point, the opening above the point being filled with concrete deposited in the tube during the withdrawal of said tube

Preparation of Milk.—The preparation of milk for delivery to customers forms the subject of a patent, No 1,000,409, to Frederick W Howe of Framingham, Mass His method consists in filling the milk bottle with milk freshly drawn from the cow and withdrawing the gases and animal heat from the milk by a vacuum producing device a permanent seal being applied to the bottle without the access of atmospheric air

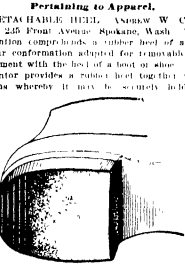
A New Conduit Creeper.—A creeper, which can be moved from one end of a conduit through or toward the other end of the conduit, has been patented, No 1,000,825, to Henry G Lehman of Windber, Pa It includes a frame, having means for releasably engaging the conduit, and a carrier movable relatively to the frame and also having conduit engaging means, and jerk ropes are connected, one to the carriage and the other to the frame so that the carriage and frame can be advanced alternately, step by step, to feed the creeper through the conduit.

RECENTLY PATENTED INVENTIONS

These columns are open to all patentees The notices are inserted by special arrangement with the inventors Terms on application to the Advertising Department of the SCIENTIFIC AMERICAN

Pertaining to Apparel.

DETACHABLE HEEL, Andrew W Carlson, 235 Front Avenue Spokane, Wash This invention comprehends a rubber heel of a peculiar conformation adapted for removable engagement with the heel of a boot or shoe The inventor provides a rubber heel together with means whereby it may be securely held in



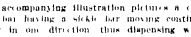
DETACHABLE HEEL

position on the heel, a rubber heel being provided with an exceptionally engaging means whereby it may be positioned on the heel A perspective view is given in the engraving showing the heel in position with the fastening means The device is adaptable for use in cases where one may desire the rubber heel at some times during the day and its removal at another time The fastening means comprises a heel number having inwardly extending portions and it is formed of resilient metal

Of Interest to Farmers.

TRAP NEST F H Sessions, Denmark Maine This invention provides means whereby it may be determined which hen has laid any particular egg and also to avoid any annoyance of the hen while on the nest It can be readily cleaned, to which end its several parts are detachable or separable and which will effectually trap the hen without preventing the fowl from leaving the nest when desired

ENDLESS CUTTING APPARATUS FOR MOWERS. J H Rogan Columbus Mont The accompanying illustration pictures a cutting bar having a sickle bar moving continuously in one direction thus dispensing with the wear and tear and heavy draft of the usual



ENDLESS CUTTING APPARATUS FOR MOWERS.

reciprocating bar, and lessening the cost of operation and maintenance of the mowing machine The cutter bar may be attached to any form of machine mower, and will run with great smoothness By removing an upper plate, the cutting mechanism may be removed for any purpose, and the bar as a whole may be made of any suitable length It is easily and cheaply operated and the mechanism is intended for a construction of long life

Of General Interest.

ELEVATED CARRIER. P J Dacuka Honolulu, Hawaii The object here is to provide a carrier for the transportation of field products merchandise and the like arranged to slidingly support the parts which forming the track for the lower supporting trolley or carriage to run on so that the cable is not liable to leave the support especially along abrupt changes in the grade of the track or cable

INSULATING COMPOSITION W Rumel Salt Lake City Utah This composition is an improved insulation for boilers steam pipes refrigerator pipes and appliances, and such other apparatus to which a non-conductor of heat is to be applied The material is cheap thick cheaper than asbestos and offers a more effective barrier to radiation between two mediums of different temperatures although it is not claimed that the composition will withstand the ravages of fire

RAILWAY CATTLE GUARD CAUSEWAY S J Billington and J A Stephenson Ellis ton, Mont This invention provides a novel structure arranged to form a shifting slipping platform to prevent the passage of cattle through the openings in fences provided for railway cuts provides means for preventing the entanglement of the parts of the platform with the structure of a moving car and provides attaching devices for the rigid structure which are simple and durable

ADVERTISING DEVICE H A Van Syckel New York N Y This invention has reference more particularly to a device in which a movable series of advertisements notices, or other announcements publications or the like, are successively presented to view, and which has means for advancing the series of advertisements and for reversing the direction of movement of the same automatically, so that the series can be repeated

HOD STAND S H Adams Phoenix Ariz The aim of the inventor is to provide a construction of folding hod stand which can be

adjusted to any size of mortar or brick hod and hold such hod when applied to the stand at any desired angle. The stand in practice may be made of wrought iron of suitable size and dimensions to give the necessary strength for supporting the hod.

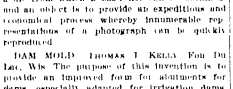
NON-REFILLABLE BOTTLE.—S. R. KELL, New York, N. Y. This non-refillable bottle is arranged to govern the discharge of the liquid from the bottle and to prevent unauthorized persons from refilling the bottle with spurious goods. For this purpose use is made of a valve in the neck and a plunger operating in the neck below the valve thereof to allow of forcing the liquid through the valve on actuating the plunger.

SHEET HOLDER.—J. PODOLAKER, New York, N. Y. The invention pertains to a holder adapted to support and secure a plurality of sheets in an assembled and readily accessible position, these sheets being of any suitable character such as newspapers, blue-prints or the like. An object is to provide a plurality of clamping faces between which any desired sheets may be secured and held in position by a lock.

CORN SUPPORT.—A. L. HAMMOND, North Platte, Neb. This invention relates generally to implements used by mule-takers and more particularly to a device adapted to bring the jaws into proper position with each other when laying out a body. The aim is to provide a chin rest especially adapted to hold the jaws in such position that in the event of the body being laid out having false teeth the said teeth will be prevented from slipping.

PROCESS FOR MAKING PRINTING BLOCKS AND STAMPS.—ALFRED J. JARMAN, New York, N. Y. This invention relates to the process of making printing blocks and stamps from photographic negatives by the use of a specially prepared printing paper, a mold and a die from which a bas-relief can be obtained and an object is to provide an expeditious and economical process whereby innumerable representations of a photograph can be quickly reproduced.

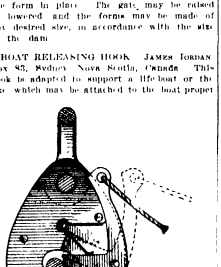
DAM MOLD.—THOMAS J. KELLY, Fon Du Lac, Wis. The purpose of this invention is to provide an improved form for abutments for dams, especially adapted for fish dams, and wherein the abutment is so arranged that the gate while supported in an efficient manner may yet be lifted to release the water or lowered to hold the same. The dam to be built is preferably composed of two abutments



DAM MOLD.

of concrete one on each side of the stream and connected by the dam proper. A plan view of the improvement is given in the illustration and it shows an abutment completed and the form removed and the other abutment with the form in place. The gate may be raised or lowered and the forms may be made of any desired size, in accordance with the size of the dam.

BOAT RELEASING HOOK.—JAMES JORDAN, Box 85, Sydney, Nova Scotia, Canada. This hook is adapted to support a life boat or the like which may be attached to the boat proper



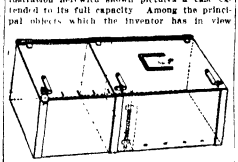
BOAT RELEASING HOOK.

or to tackle and which is adapted to automatically release the boat from the supporting members by the simple movement of a catch. The invention provides a releasing hook in which the weight is supported on a stationary member, and in which the link engaging the hook is held in position on the supporting member by a latch, so that little or none of the pull on the link will be exerted on the latch so that the latter will be readily operated and certain which the parts are so arranged that any tendency of the link to slip out of position will draw the latch down so as to more firmly hold it in place. The engraving shows a fragmentary view of a boat with the device attached thereto.

HORSESHOE.—N. SAWCHUK, New York, N. Y. This invention has reference to horseshoes, the more particular purpose being to provide a shoe to be connected with the horse's foot without the aid of nails or other similar fastenings, and also without the necessity for any part binding tightly upon any sensitive portion of the hoof.

FOUNTAIN BRUSH.—W. L. PERLEE, Greenville, Texas. In this improvement use is made of an apertured brush body provided with lateral an apertured casing mounted to slide on the body, a valve adapted to normally close the apertures in the casing, a spring in the casing and adapted to engage the valve with the said casing, and a second casing adapted to constitute a cover for the brush body and a reservoir for a liquid or a holder for the fountain brush liquescent substance.

COLLAPSIBLE PACKING CASE OR TRUNK.—E. S. SHEPHERD, 1462 E. 94th Street, Canarsie, Brooklyn, N. Y. The illustration herewith shown pictures a case extended to its full capacity. Among the principal objects which the inventor has in view

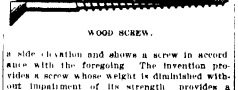


COLLAPSIBLE PACKING CASE OR TRUNK.

are: To provide a carton or case or trunk for transshipment of merchandise or other goods which may be adjusted to size to meet the requirements of shipments and to economize the cost of handling by reducing the bulk dimensions of the returned or empty case, to provide a structure for boxes or cases of the ordinary character mentioned which is more durable than the form at present provided, and to provide means for locking the case which automatically locks or fixes the size of same.

Hardware and Tools.

WOOD SCREW.—R. DEWITT BURDICK, Lincklaen Center, N. Y. Inventor: I. L. Messenger. A wood screw constructed in accordance with the present invention differs from the ordinary screw in that the opposite sides thereof and longitudinally disposed thereon, channels are formed. The engraving illustrates



WOOD SCREW.

a side elevation and shows a screw in accordance with the foregoing. The invention provides a screw whose weight is diminished without impairment of its strength, provides a screw the threads whereof are sectioned to form a plurality of cutting edges for the threads and a relief passage in the barrel of the screw, and provides a screw the head whereof permits the use of a counter-sinking driver.

STROPPING MACHINE.—J. W. HAWKINS, Passaic, N. J. In this device a drum is provided having a blade supporting roller on each side of the drum so arranged that when the rollers are engaged with a plane surface, the portion of the drum between the rollers will also engage and roll on the same surface, thus rotating the drum, and causing the rollers to hold the blades against the drum in stropping position.

RIVET MAKING DEVICE FOR CHAINS.—FRANK B. WIDMAKER, 2312 Broadway, New York, N. Y. This device may be readily carried in the tool bag of a motor-cycle or automobile, for use in repairing the drive chain of



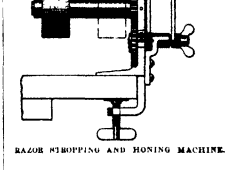
RIVET MAKING DEVICE FOR CHAINS.

the machine. It includes a punch and a hammer for driving the rivet out of the punch. The head of the hammer is so constructed to receive and hold the chain, while the punch serves as a handle to turn a screw on the head of the hammer, to loosen the rivet preparatory to driving out the last. The device is shown in the engraving with the parts in position for starting a rivet from a chain, for which it is generally useful, but it is especially designed for use in the repairing of the drive chains of automobiles and motor vehicles.

HARNESS BUCKLE.—T. MCNARY, Jackson, Tenn. This inventor provides a buckle in which the tongue passes through the perforation in the article to be buckled instead of passing through it in a slanting direction, the ordinary form serving to wear the strap on one edge and to eventually cut it. Strain on the tongue is relieved by plates which serve to protect the tongue and also to clasp the straps over the side, this assisting in holding the strap in place.

RAZOR BLADE STROPPER.—I. KLEIN, New York, N. Y. The invention refers to a device for use in holding safety razor blades of various types during the operation of sharpening. The sharpener comprises a holder consisting of a plurality of leaves hinged together and having projections and recesses for securing the different types of safety razor blades so that they can be readily stropped or sharpened in any suitable manner.

RAZOR STROPPING AND HONING MACHINE.—CHRISTIAN ALTER, 500 E. 83rd Street, Manhattan, New York, N. Y. The object of the inventor is to provide a stropping and honing machine (a plan view of which is shown in the engraving) arranged to permit stropping or honing of ordinary razors



RAZOR STROPPING AND HONING MACHINE.

or the blades of safety razors in a very simple manner, it being only necessary to exchange a stropping wheel for a honing wheel when using the machine for stropping or honing purposes. For this result use is made of a wheel having a peripheral stropping or honing face and mounted to turn in either direction and to travel in the direction of its axis and a holder for the blade mounted to rock to present either side of cutting edge of the blade to the peripheral face of the wheel, according to the direction to which the wheel is turned.

PIPE WRENCH.—P. J. MCGUIRE, New York, N. Y. This pipe wrench embodies a flexible gripping member, ordinarily in the form of a chain at the end of a lever, and has in view such a wrench in which substantially no travel of the lever is required to draw the gripping member tight about the pipe or fitting after the member is applied, and which effectively grips the pipe or fitting for substantially the full circumference.

Heating and Lighting.

DRIER.—P. JACKSON, Macon, Ga. This invention is an improvement in driers embodying a rotary tubular conveyer, and has in view such an appliance in which the hot gases from a furnace are discharged through the conveyer in a direction opposite to the travel of the materials to be dried, the furnace and conveyer being arranged end to end, with the discharge end of the conveyer constructed to shower the materials through the hot gases and flame of the furnace.

LAMP BOX.—W. R. BOWLES, Hopkinsville, Ky. In this case the object of the improvement is to provide a simple and inexpensive box especially adapted for photographic work and wherein a negative, picture or other object to be operated upon may be illuminated to the best advantage and with the proper character of light.

Household Utilities.

FURNITURE FOOT SOCKET.—O. TRINDER, East Douglass, Mass. This invention provides a rest in the form of an adjustable cup head for the legs of a radiator or other article of furniture, the vertical dimension whereof may be varied, provides in a device of this character means for partially locking the device in set position, and provides a device which is simple, economical and durable in construction.

Machines and Mechanical Devices.

PROPELLER FOR AEROPLANES.—T. S. HARRIS, Waverly, Ill. Among the principal objects which the present invention has in view are: to provide a propeller wherein the rotation of the same is automatically governed; to provide means for manually controlling the adjustment of the governor; and to provide a simplified, efficient and durable construction for a propeller.

LOADED TRUCK COUNTING APPARATUS.—E. MCGARRY, Walla Walla, Wash. This invention provides a platform and compensator operatively connected therewith for ascertaining the succession of loaded trucks or conveyances passed over the said platform; provides a platform to operate under conditions of load only; and provides a platform and compensator connected therewith constructed and arranged in a manner economical, durable and efficient.

LIQUID PISTON VACUUM PUMP.—M. A. MOULIN, 303 Rue du Faubourg St. Antoine, Paris, France. This invention is characterized by the employment of a frictionless and loosely fitting piston whose tightness to gas is insured by a liquid without appreciable vapor pressure, which need not be lubricating, which by reason of its viscosity leaks through slowly in comparison to the speed of the system; the liquid escaped being afterward utilized to drive out gas filling the space where it is not wanted. A complete vacuum may be rapidly attained with little liquid, an important point when mercury is used.

AERIAL VESSEL.—S. A. NOBLES, Albany, N. Y. The object here is to provide an aerial vessel or aerosel, of the kind known as heavier-than-air flying machines, the vessel being provided with large sustaining surfaces capable of being moved to support the vessel, to elevate or lower the same, to propel and steer and to automatically restore the equilibrium of the vessel when struck by contrary air currents.

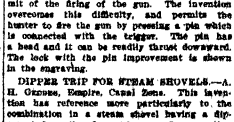
COPY HOLDER.—B. F. PERRY, H. S. MCDANIEL and N. W. THOMPSON, Portland, Ore. An object of this improvement is to provide a copy holder in which the copy may be fed forwardly by the mere act of operating the typewriter machine. It relates more specifically to novel means for effecting the feed of the copy in which the feed mechanism may be operated by the movement of the typewriter itself, or manually if desired.

VALVE.—S. STUCKY, Oxford, Ala. In this instance the purpose of the invention is the provision of a mechanism for use with ordinary form of outlet valve casing for closing the passage of the valve casing, when the valve is removed for any purpose, and wherein the said mechanism is normally held in inoperative position by the valve.

STOCKING FOLDER.—A. L. PATTERSON, Albemarle, N. C. The improvement is a means provided for folding stocking tops preliminary to sewing the same to form the hem at the top of the stocking and the invention includes means by the use of which the stocking may be folded accurately and to any part thereof as desired, ready for sewing on a hemming machine. The stocking tops may be folded to any desired width of hem which may be varied according to the length or extent of movement of the blade.

RIVETING MACHINE.—H. LLOYD, Lexington, Ky. In this patent the object of the invention is to provide a very powerful hand operated device which will be light, compact and handy, easy to operate, and consisting of but few parts. The device is a die having an anvil co-operating therewith provided with means for holding a rivet in position to cooperate with the die to perforate a sheet of metal, the hammer and anvil being further provided with means for heading the rivet.

FIRING MECHANISM FOR GUNS.—ETHAN ALGER, 214 Arizona Avenue, Lorain, Ohio. Mr. Alger's invention has reference to firing mechanism for guns, and it has for its object



FIRING MECHANISM FOR GUNS.

the provision of means for firing a gun which may be readily actuated with heavy guns or warm mittens. In hunting in winter weather it is very difficult to pull the trigger when gloves or mittens are worn, and without gloves or mittens the fingers become too numb to permit of the firing of the gun. The invention overcomes this difficulty, and permits the hunter to fire the gun by pressing a pin which is connected with the trigger. The pin has a head and it can be readily thrust downward. The lock with the pin improvement is shown in the engraving.

DIPPER TRIP FOR STEAM SHOVELS.—A. H. GEROME, Empire, Canal Zone. This invention has reference more particularly to the combination in a steam shovel having a dipper, a door, therefor, and means for operating the dipper, of a latch for the door, a cylinder to receive a rigid under pressure, a piston in the cylinder, a pivoted lever operatively connected with the piston, an operative connection between the lever and the latch whereby the piston can be actuated to release the door, and a dead stop to limit its movement.

CONDENSED HANDLE AND PULLEY FOR CREAM SEPARATORS.—P. A. FREEMAN, Slot Springs, S. D. It is important that centrifugal cream-separators shall be run at a uniform speed, and, since the pin customarily used

machine ordinarily employed for driving them often, such as varying speeds, or, in coming machines, have a "jerky" motion, spring attachments have been devised for connecting the band-wheel or pulley with the shaft of the separator. Mr. Shoberg's invention is an improvement in this line.

ROTARY PUMP.—A. P. SMITH, Winnebago, Nev. This improvement provides a pump wherein the lifting power is supplied by weighted members which may be varied to harmonize with the conditions under which the pump is working; provides a mechanism wherein the lift of the water on the intake side of the pump is produced by the fall of the weighted members; and provides a mechanism the operation whereof is balanced to cooperate in the function of the pump.

HYDROSTATIC MOTOR.—J. G. MACMILLAN, Oakland, Cal. This invention has reference to hydrostatic motors, and has for an object the provision of a motor of this character with means so that the lifting force of water is concentrated and delivered at one point and readily converted into motive power for operating various power driven machines.

Prime Movers and Their Accessories.

PACKING FOR PISTON RODS OR THE LIKE.—G. H. ROBINSON, 93 Grace Church Street, London E. C., England. This invention pertains to packing for piston rods or the like, and the object is to provide a packing which, besides being capable of holding a thoroughly fluid tight joint, is easy to construct, capable of conforming to the shape of the piston-rod or other moving part in connection with which it is being used, and very durable.

ROTARY ENGINE.—W. ALEXANDER, 4 Rosenau Crescent, Battersea, London S. W., England. This invention has reference to fluid pressure engines (including air compressors, blowers and the like) of the rotary type in which there is an inner revolving or rotative drum, within an outer rotative drum or casing and in which abutments, hinged to the drum or casing, are arranged to move in the spaces between the inner and outer drums.

DAMPER.—L. SLIGHS, Indianapolis, Ind. In this instance the inventor provides an air inlet made somewhat upon the principle of an iris diaphragm, and so arranged as to be easily connected with the throttle and actuated by movements thereof, the iris diaphragm being also adjustable at the will of the operator for the purpose of varying its character.

Pertaining to Recreation.

AMUSEMENT APPARATUS.—A. E. WEST, Portsmouth, Ohio. Mr West's invention is embodied primarily in a pivoted circular platform adapted to oscillate vertically, and whereon a car or truck is adapted to travel, the required impetus being derived from the motion of the platform, which is produced by hand power, a spring, or any other form of motive power.

Railways and Their Accessories.

RAIL CHAIR AND BRACE.—O. PETERSEN, New York, N. Y. An object has been to provide means by which both the running rail and the guard rail can be securely positioned upon the tie, which permits the rails to be removed without displacing the chair itself, which tends to lengthen the life of the ties by obviating the necessity of pulling and driving the spikes or holding bolts in the removal of the rails and which obviates the necessity of providing drill or other holes in the rail webs.

MACHINE FOR GROOVING RAILWAY SLEEPERS.—F. ALTENSTEIN, Budapest, Austria-Hungary. This invention relates to machines for cutting into the upper surface of the sleeper or tie transversely disposed grooves to receive the tie plate and relates more particularly to machines in which the tables supporting the ends of the blank during working are first positively forced downward into their lowermost position in which the blank is pushed upon them, whereon each of the tables is raised by weights or springs for bringing the blank into the proper position relatively to the cutters.

Pertaining to Vehicles.

HOIST.—H. L. MCCOY and W. B. BOATRIGHT, Mathis, Texas. The intention here is to provide an easily operated device for the character specified for lifting vehicles, especially motor vehicles of considerable weight, by means of which the heaviest vehicle may be lifted with a small expenditure of force, and may be held in elevated position and without changing the relative position of the parts of the vehicle.

REED FOR MOTOR HORNS AND THE LIKE.—DOMINGO TERRA, 18 Rue des Rois, Paris, France. The object of this invention is to remedy numerous defects and it consists in providing a reed for motor horns and the like wherein the different parts can be detached with the greatest ease, either for cleaning purposes, or for restoring the curvature when damaged.

NOTE.—Copies of any of these patents will be furnished by the SCIENTIFIC AMERICAN for ten cents each. Please state the name of the inventor, title of the invention, and date of this paper.

NEW BOOKS, ETC.

THE SOCIAL DIRECTION OF HUMAN EVOLUTION. By W. E. Kellicott. New York: D. Appleton & Co., 1911. 349 pp. Price, $1.50.

In ministering to the welfare of the community, the philanthropist and social reformer, like the physician attending the individual, faces a double problem. First he must correctly diagnose the evil which he seeks to remedy. Once the trouble is recognized, and its nature properly understood, there remains the task of discovering or devising a suitable treatment. There have never been wanting those who have labored with self-sacrifice and in truly altruistic spirit for the good of the less favored strata of human society, and especially within the last century or so the systematic care for the sick and defective has developed to a stage of excellence which we may well witness with gratification. But while there can thus be no doubt as to the good motives which have been at work, the question has been raised, particularly by the advocates of "eugenics," whether some of the steps taken have not been based on a false or at least incomplete diagnosis of the trouble. It is pointed out that our asylums and hospitals and other philanthropic institutions, indeed, do a noble work for the individual, but that the benefit thus conferred is evanescent, lasting at best for a lifetime, and requiring ever renewed efforts in each generation. We are combating the symptoms, instead of seeking to eradicate the disease. Says the author

"If we could by education, by legislation, or by social effort, change the environmental conditions, would the race at once rise to a markedly higher standard of physique and mentality? Much, if not the whole battle for social reform, has been based on the assumption that this question can be answered in the affirmative. No direct investigation has really ever been made of the intensity of the influence of environment on man. To modify the obviously repellent was the immediate instinct of the more gently nurtured and controlling social class. Was this direction of social reform really capable of effecting any substantial change? Nay, by lessening the selective death rate, may it not have contributed to emphasizing the very evils it was intended to lessen?"

To show how intricate some of the questions involved are, new measures taken with the very best intentions may lead to wholly unlooked-for results. "We might point out that several movements apparently of high social value have been attended by a curious and largely unforeseen back action. Thus the enforcement of certain forms of employers' liability laws has led to discrimination against married persons by large employers of labor, and a premium thus put upon non marriage. The result of child labor legislation has been in some cases an enormous rise in the death rate of young children among the classes concerned, indicating that the children receive less care, now that they have ceased to be a prospective family asset, and have become chiefly a burden for many years. In other cases the result has been so serious a limitation in the birth rate that communities are dying out and factories are closing for want of workers."

There can be little doubt that the right standpoint from which to attack the problems involved is that of eugenics. In the volume under review the author brings before the reader in logical sequence the data, from scientific (biological) basis, and the "programme" of eugenics. Naturally much attention is paid to a discussion of the phenomenon of heredity, and Mendel's law of heredity has been given full scope. How terrible is the inherited bias for crime and ineptitude is shown by the records of the Jukes family of New York State. This family is traced back to 1720. Of 1,200 members whose history is known, 310 died in infancy. Of the remaining 900, 350 were professional paupers; 440 were wrecked by their own diseased wickedness; more than half of the women were prostitutes; 130 were convicted criminals, 60 habitual thieves, and 7 murderers! They cost the State over a million and a quarter dollars, and this cost is still going on.

These subjects are now, and rightly so, much in men's minds, and Prof. Kellicott's book is well calculated to form a valuable addition to the growing literature on eugenics. The value of works of this kind, which bring before the people at large the vital facts and principles of a topic of supreme importance, can hardly be over-estimated. In particular, Prof. Kellicott's book commends itself for its conciseness, the apt way in which the chief points are worked out and clearly laid down. The presentation is in every way attractive, and the book should prove interesting and most profitable reading to all classes.

HOW TO READ PLANS. By Charles G. Peker. New York: Industrial Book Company, 1911. 12mo.; 104 pp; illustrated. Price, 50 cents.

The writer answers the question, "How can I learn to read a drawing?" by saying that the best way is to learn to make a drawing. Architectural layouts in plan, elevation and section are simply illustrated and described, with an explanation of the various markings and instruction as to following to scale. The methods of designating walls, doors, columns, windows, the swing of doors, and so forth, is given, with a list of the symbols and abbreviations in use. There is a complete set of plans for a six-room frame cottage, and in conclusion the student is warned against some mistakes he is likely to make in his first attempts at plan-reading.

IDRAULICA. Ing. Dott. Edgardo Zeni Milan: Ulrico Hoepli, 1911. 16mo., 503 pp.

The handbook begins with a rather extensive bibliography of the subject, and follows this with the tables and formulas in common use. Other sections of the manual take up the various branches of the subject in logical order, leading the reader on from the constitution and properties of water and its behavior under natural conditions, to the principles and processes of hydrostatics and hydraulics. Two hundred and fifty engravings and a large insert add to the manual's attractiveness and enhance its value.

MANUALE DI LIVELLAZIONE PRATICA. Compilato da Mario Veglio. Milan: Ulrico Hoepli, 1911. 12mo., 130 pp., 47 illustrations.

A concise description of the various types of instruments in use, with their methods of application to the common exigencies and problems of field work.

CONCRETE WORKERS' REFERENCE BOOKS. By A. A. Houghton, New York: The Norman W. Henley Publishing Company, 1911. No. 3. Practical Silo Construction. No. 4. Molding Concrete Chimneys, Slate, and Roof Tiles. No. 5. Molding and Curing Ornamental Concrete. No. 6. Concrete Monuments, Mausoleums and Burial Vaults.

These booklets represent a part of a series of practical monographs on popular concrete subjects. The author's purpose has been to present not only the usual types of construction, but to fully explain and illustrate molds and systems that are not patented, which are equal in value and often superior to those restricted by patents. Each book is fully illustrated and the subject is treated in plain English.

UNSOUNDNESS OF MIND. By T. S. Clouston, M.D., LL.D., F.R.S.E. New York: E. P. Dutton & Co., 1911. 8vo., 360 pp.; 14 illustrations.

Unsoundness of mind is here treated in its very broadest aspect, for Dr. Clouston's book covers all that vast region, pathological, sociological, and pathological, that lies outside of the normal mind. Among the diseases which a physician might classify as those of a mentally abnormal person, he finds that can not be sharply defined from normal mental states. Because there is no reliable test between soundness and unsoundness of mind, the author has necessarily included in his book much that is particularly outside the line. The book as a whole is an excellent example of good popular scientific writing of a kind that will do much to enlighten the public on special problems which are only vaguely appreciated and to which a certain amount of odium is unfortunately attached.

THE BIRTH OF WORLDS AND SYSTEMS. By Prof. A. W. Bickerton. London and New York: Harper & Brothers, 1911. 16mo., 162 pp.

More than thirty years ago Prof. Bickerton published in the New Zealand Philosophical Institute a theory to account for the origin and life history of new stars. Prof. Bickerton's viewpoint that these celestial flashes result from the impact of two celestial bodies has been adopted by many scientists of note, chief among whom is Svante Arrhenius, who, in his book "Das Werden der Welten" and also review of his book before us. Although the theory is not yet generally accepted, it certainly explains in a most plausible way a number of astronomical phenomena that have long been puzzling.

THE PRINCIPLES OF ELECTRO-DEPOSITION. A Laboratory Guide to Electro-Plating. By Samuel Field, A.R.C.Sc., F.C.S. New York: Longmans, Green & Co., 1911. 8vo.; 383 pp.; illustrated. Price, $1.80 net.

The writer believes that many who are interested in electro-plating are in need of a more thorough knowledge of fundamental principles. The opportunity of attending classes is by no means open to all, and the present volume is offered as at least partly filling the need of special instruction. An elementary knowledge of chemistry is taken for granted, details of shop practice are but briefly mentioned. The exclusive use of the metric system is not insisted upon. Apparatus, standard solutions, tools, and processes are explained at length and there is a comprehensive appendix of tables and general information.

GRAMMAR SCHOOL READER. Book One. By William H. Elson and Christine Keck. New York: Scott, Foresman & Co. 12mo.; 344 pp. Price, 50 cents.

The selections brought together within the covers of the Elson Reader are all old favorites. The arrangement follows an ascending scale of difficulty and literary quality, and there are review questions, words and phrases for study, and three fine biographical notes on the authors of the selections. We protest against the inclusion of "Casabianca" which has no poetic or literary value and has been parodied so often that it now appeals only to the child's sense of humor. If it carries any moral it must be to the effect that unintelligent obedience brings its own punishment.

Notes and Queries.

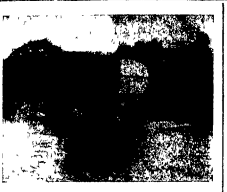
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(12529) F L R asks: What makes a horse hair when placed in still water wiggle like a snake? When one holds a hair of a horse in the hand it doesn't move a particle, but placing it in water starts the movement. What I would like to know is what furnishes the power for the movement? A. Any motion a horse hair may have when put into water is caused by its power to absorb water and to bend or twist as the water causes the hair to swell on the side nearest to the water. This will take place in the air. If you hang a long hair by one end and tie to the lower end a light rod of wood or a piece of straw or paper, the hair will bend so that it will twist back and forth from day to day.

(12530) C T C asks: In an air pump that drawn out 2 inches makes a practical vacuum, the outside air pressure is said to be 15 pounds to the square inch. Now suppose the piston to be drawn out to 4 inches and 6 inches and 8 inches, is the air pressure on the piston any more at 8 inches than it is at 2 inches? A. If there is no space whatever between the piston and cylinder head no "clearance," there will be a perfect vacuum (theoretically) behind the piston the instant after it commences to move, and an unbalanced pressure of 14.7 pounds per square inch on the opposite face of the piston, and this pressure will not increase as the piston is drawn out. In fact, the atmospheric pressure may be considered constant while the pressure behind the piston, equal to atmospheric at first, drops instantly as the piston begins to move.

(12531) H L W says: Can you lower the temperature of ice below 32 deg. F. if so what ratio will it bear? Supposing the temperature of the surroundings bear with the temperature of the ice? A. Ice like any other solid, takes the temperature of the place in which it is when that temperature is below its melting point. In a cold night when the temperature is at zero, a block of ice will cool to zero, just as the stones do and as rapidly according to some experiments, while others seem to show that it will cool less rapidly than the stones. Ice does not have the same properties of other solids. Its melting point is low as compared with most solids, and for that reason, we suppose people do not usually associate it with solids.

(12532) H C says: I read somewhere some years ago, that the moon possessed a satellite, but that it was so minute in diameter, occasionally visible. I have seen no other reference to it and cannot now place the reminiscence. Is this a fact? A. No satellite of the moon is known to exist. These statements are made in a book in the autumn issue. 2. Why do the etheric waves used in wireless telegraphy bend round the earth? Why do they not take their way through the other altogether irrespective of material bodies? A. The ordinary form of a wireless telegraph apparatus is equivalent to one half of a Hertzian oscillator, the other half of which is the earth. A complete Hertzian oscillator does give off waves which go through space like light, quite independent of the earth. A grounded oscillator gives off half waves, the lower part of which are not closed lines, but terminate in the earth, and cannot separate from it. They therefore follow the curvature of the earth's surface. They are also thought to produce or to be accompanied by alternating currents of electricity in the earth's surface. These electric currents must overcome the resistance of the material through which they are moving. This resistance will be less in water or moist earth than in dry materials, so that signals can be transmitted to a greater distance over water than over land. In the day time the air is rarefied by the sun, rendering it less moist, more opaque to other waves, thus rendering communication more difficult than in the night time. Both these well-known difficulties in wireless telegraphy are due to the fact that the etheric waves do not move as true waves in space, but employ the earth for one side of the wave as a material point of attachment. See Poincare and Vreeland's Maxwell's Theory and Wireless Telegraph, which we will send for $2.00 postpaid.



An interesting experience with Polarine

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August 11, 1911

Standard Oil Company,
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Eastern Sales Manager

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Standard Oil Company
(Incorporated)

The New British Dreadnoughts

(Concluded from page 230)

accommodation is 3,500 tons of coal with considerably over 1,000 tons of oil fuel in addition, the subsidiary engines are driven by steam and not by Diesel engines as in previous battleship-cruisers In spite of the high horse-power and heavy battery, sufficient proportion of weight has been found to adequately protect the ship against shell fire and submarine explosion The belt is of 9¾-inch Simpson steel thinning to about 4 inch at the bow and stern, leaving a space of 20 feet unprotected at the ends, the hull being minutely subdivided in lieu of the armor. The barbettes are of 11 inch plate, the hoods being 12 inch, a protected deck of 2¾ inches and subdivision by bulkheads is utilized on similar lines to the "Orion." The conning-tower is of a new and splinter-proof pattern, there being no apertures in the tower itself but a large dome-shaped projection rises from the rear of the roof provided with slots giving an almost all-round view. A second tower is situated aft of the after wireless telegraphy pole-mast

Taking into account the speed gun power, and protection of this ship, it is debatable whether the fighting power is not equivalent or superior to that of the "Orion" It must be admitted that the British Admiralty and their boards of construction have evolved in these ships war machines with an unprecedented potential power of destruction in view of the limitations imposed upon them by cost and displacement The ships now building or authorized ("King George V" and "Queen Mary" classes) are of the same general type as the "Orion" and "Lion," but improvements have added somewhat to the displacements What further perfection and also whether the limit of size has yet been attained in these huge ships can only be shown by the passage of time

Artificial Life

(Concluded from page 231)

of foam The microscope does not tell us all that we should like to know—and it tells us one thing at one time, and other things at other times It is quite possible that the "structure" of protoplasm is different in different organisms, or that it is different in different parts of the same organisms, or that it is different within the same cell under different conditions At any rate, Prof Butschli, to demonstrate his idea of the "alveolar" or foam-like structure of protoplasm, mixed some finely powdered potassium carbonate with olive oil that had been heated from 125 to 140 deg F The oil becomes partly saponified, producing an acid This acid reacts on some of the carbonate, producing minute bubbles of carbon dioxide Under the microscope a drop of this frothing mixture looks like a stock of protoplasm and the movements in it even resemble the streaming in a living cell

Some fifteen years ago these experiments were hailed by certain journalists as successful attempts to produce artificial life But no one who knows any thing about the problem, least of all Prof Butschli, thought that these experiments had anything to do with the creation of life The experiments were successful in the sense that they gave us a working model made of familiar materials, to help us understand the minute structures and movements within the cell How hard error does die is suggested by the fact that these experiments have been described over and over again in all grades of publications as a method for making "artificial protoplasm" until this very year

After the fact of cell-structure in organisms had become well established, one of the problems that interested the experimentalists was that of the growth of the cell wall, which to all appearances is not itself alive To test the theory that growth is produced by a stretching of the membrane with subsequent deposition of new material in the interspaces of the old wall, Moritz Traube carried on some very suggestive experiments He allowed a solution of sugar and gelatine to come in contact with a solution of tannin through the narrow opening of a small tube Now as soon as the tannin touches the gelatine it forms a membrane through which the water may easily pass, but through which the sugar cannot pass at all. The globule within the membrane continues to absorb water from the tannin solution by osmosis, stretching the membrane. The membrane *grows*, and under certain circumstances puts forth branches in various directions, the whole taking in the appearance of some weird plants or "sea weeds"

Traube's further experiments, from 1865 on, and those of others, extended our knowledge of osmosis, threw some side lights on the mechanism of the cell-growth, and furnished amusement to many persons, for these osmotic gardens are curious and somewhat mystifying But no biologist has in all these years suspected that Traube's phenomena were in any way related to "artificial life" until a few years ago Dr. Stéphane Leduc, professor of physics in the medical faculty of the University of Nantes, announced that he had discovered the physico-chemical foundations of life. He presented before the French Academy of Sciences a large number of demonstrations, in which he made "plants grow from artificial seeds" These seeds consisted of sugar plus some salt that would form a precipitation membrane with the substances of his growing medium For example, copper sulphate in a "seed" would cause growths in a solution of potassium ferrocyanide These growths were in no way different from those obtained by Traube and others, except that Leduc used a larger variety of substances in his experiments than had been used by other experimenters Anyone can make for himself a garden of such "artificial plants" with very little trouble Perhaps the easiest way is to place at the bottom of a jar a number of crystals of salts of heavy metals (e g, sulphates of copper, iron, zinc, cobalt) and carefully pouring over them a 10 per cent solution of sodium silicate or "water glass" The insoluble silicates of the metals will form the membranes, osmosis will cause them to stretch, variations in the density of the medium will cause irregular branching, and the colors of the salts within the membranes will give a further resemblance to "plants" (Fig 1 and Fig 1a)

Leduc went farther, however, and produced imitations of living structures down to the smallest details By placing a drop of colored salt solution into another solution of lower concentration, he produced "artificial cells" More definite cell membranes are produced by placing drops of 10 per cent solution of potassium ferrocyanide in a 10 per cent gelatine solution (Figs 2, 3) The appearance of nuclear division within a cell he produced by placing two drops of some solution near each other within another solution (Fig 4) That all these phenomena are due to osmosis or diffusion is well known to all physicists, that they are not in any true sense identical with "growth" and "nuclear division" may be known only to the student of biology Among other demonstrations made by Leduc in this connection was the formation of a "field of force" by the diffusion of liquids of different densities (Figs 5, 6, 7)

That the "artificial life" of Leduc had no real bearing on the fundamental physiological problems has been shown repeatedly, and Prof. Leduc has in later statements denied that he confused his phenomena with life processes, although his original confusion is on record in the proceedings of the Academy. Perhaps the best analysis of Leduc's results is that of Prof Maurice D'Hulin, director of the physiological laboratory at the University of Lille. This experimenter not only repeated all of Leduc's "demonstrations" but even showed that the various weird forms assumed by the "artificial plants" could be controlled by changing the concentration of the solutions, or by changing the proportions of the different materials used. Nevertheless we still find fairly frequent references to Leduc's overstepping the threshold between the non-living and the living by means of "artificial seeds."

In the spring of 1905 we had another "artificial life" sensation in the announcement that Mr. John Butler Burke, "of the Cavendish Laboratory of Cambridge University," had obtained some curious, life-like structures from the action of radium upon sterilized bouillon. Mr Burke was following up a sugges-

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this made many years before by Prof. E. Pflüger of the University of Bonn, that the essential difference between living protein and non-living protein lay in the fact that in the former oxidation or transformation of energy is *internal*, and that this internal oxidation could perhaps have been induced by cyanogen, a compound of carbon and nitrogen which was probably produced during the incandescent stage of the earth's history. Having failed to induce phosphorescence or other indications of the internal transformation of energy in organic substances by means of cyanogen, Mr. Burke resorted to radium

The test-tubes containing gelatine and beef-extract in the proportions used for bacteriological cultures were properly sterilized, and a minute quantity of radium chloride or bromide was added. The appearance of the gelatine changed, suggesting bacterial growths. Under the microscope there were seen tiny roundish bodies that increased in size, divided and moved about slightly! This was certainly life-like. In order to make sure that they were not bacteria due to contamination, the tubes were examined by Dr. Sims Woodhead, professor of pathology at Cambridge This authority declared they were *not* bacteria at all They were not even living things, for they dissolved in water; they disappeared entirely after standing in diffuse daylight for a little while, to reappear after a few days of darkness. Moreover, on being transferred to fresh bouillion, they did not increase in numbers

But the world was clamoring for artificial life; Burke could not lose so good a lead. Instead of calling his new discovery bacteria, which they were not, he called them "radiobes," implying that they were life-like things produced by radium. They were unlike any other living thing, so Burke set to work and elaborated a new definition of life, so that the radiobes could fit in Otherwise he should not have created "artificial life."

That the radiobes were not living things, in the accepted sense of the word living, must be obvious to nearly everyone But what are they then? Prof. Sir William Ramsay explains these structures are due to bubbles of hydrogen and oxygen gas (arising from the decomposition of water by the radium salt) and "radium emanation." The "growth" is due to the continuous production of more gas by further decomposition of water by the emanation within the bubble; the expansion of the gas might also lead to the breaking up of the bubbles into two or more (Fig. 8.)

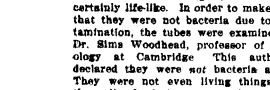


Fig. 8.—Radiobes in various stages of division. After Burke.

At any rate, the water-soluble radiobes are not alive, and it was later found that they could be produced in the bouillion by other substances besides radium, such as salts of barium, strontium, and lead. "Radiobes" produced by these substances also have "nuclei" consisting of insoluble sulphates of the metals used

The failure of scientists so far to produce "artificial life" is not to be charged against the science of biology. Very few of the attempt to produce "artificial life" have been made by biologists; who realise too well the complexity of the problems involved. The biologists will be satisfied for a number of years to come if they succeed merely in analyzing what goes on in a living cell, in terms of physical and chemical processes From time to time they will attempt to imitate a structure or a process by means of a working model; but they will not speak of artificial life until they are quite sure of all the conditions that play a part in this most intricate of phenomena.

The Solar Constant.—In the *Proceedings of the American Philosophical Society*, May-June, 1911, Mr. C. G. Abbot defines the solar constant as "the number of degrees by which one gramme of water at 15 deg. C. would be raised, if there should be used to heat it all the solar radiation which would pass at right angles in one minute through an opening one centimeter square, located in free space, at the earth' mean solar distance." Experiments were begun about 1835 by Pouillet and Sir John Herschel for the measurement of this great constant of nature, and the investigation has been continued by Forbes, Crova, Violle, Radau, Langley, K. Angström, Chwolson, W A. Michelson, Rizzo, Hansky, Scheiner, Abbot, Fowle, and others. The difficulty of the problem is shown by the fact that until a few years ago entire uncertainty prevailed as to the value of the solar constant, between the limits of Pouillet's value, 1.76 calories, and Angström's value, 4.0 calories per square centimeter per minute. The author and his colleagues have made over 400 observations with special apparatus, including the silver-disk pyrheliometer, an absolute water-flow pyrheliometer, and the recording spectro-bolometer, at Washington, Mount Wilson and Mount Whitney, to determine the value of the solar constant and its possible fluctuations; and they now announce a mean value of 1 922 calories, which may prove to be 1 or 2 per cent too low, as the observations have been made mainly near the time of sunspot maximum, and hence of diminished radiation This value is, moreover, subject to fluctuations amounting to about 8 per cent, at irregular intervals of a few days, and these fluctuations are thought to indicate a true variability of the sun itself In other words, the solar "constant" is probably variable

The Current Supplement

WE have previously had occasion to refer to the fact that the United States Post Office is finding it economical to do some of its own printing, instead of giving out the work to contractors, as heretofore In the current issue of our SUPPLEMENT, Mr Gunnaway describes the arrangements which have been made for printing money orders on the government's own presses—In the second installment of his article on the Great Star Map, Prof Turner deals with the subject of "Star Counting" A note on the Variation in the Purchasing Power of Gold should prove of general interest — We like to keep track, not only of progress at home, but also of the course of events abroad An article on the electrification of suburban lines in the British capital is published with this subject in view—We have seen the automobile invading a great variety of fields of usefulness. The motor car to the rescue is the modern cry when fire threatens property and life, as is illustrated by an article on a new auto-fire-engine —The article on Practical Aspects of Printing Telegraphy reaches its seventh instalment in this issue —The Mechanical Handling of Freight is a most important technical problem, to the study of which new contributions are added every day One example of this is shown in an illustrated article—Factory Economy is the guiding principle ever before the eyes of the works superintendent. A description of an immense superheater utilizing waste heat and installed in one of the plants of the United States Steel Corporation is interesting in this connection —An article from the pen of the great scientist Prof Wilhelm Ostwald, on the Biology of the Savant, brings us one of his lucid studies in the psychology of great personality — The extraction of crude cocaine and its refining process is described in an article derived from the *Engineer*.

Materials for Paper Money

THE materials that go to make up our paper money are gathered together from all parts of the world. Part of the paper fiber is linen rag from the Orient. The silk comes from China or Italy. The blue ink is made from German or Canadian cobalt. The black ink is made from Niagara Falls acetylene gas-smoke, and most of the green ink is green color mixed in white zinc sulphite made in Germany

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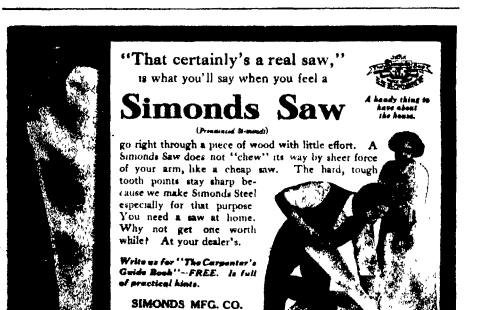
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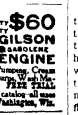
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Aeronautics

A New World's Record Flight With a Passenger.—Besides the new height record made by Beachy at the Chicago meet, Wm Beatty set a new mark for endurance with a passenger by remaining aloft with Fred Wagner, a photographer of the Chicago Tribune no less than 3 hours, 42 minutes, 22 1/5 seconds. The new record beats by 23 minutes that made by Amerigo with an Aviatik aeroplane in Germany some time ago. Beatty accomplished the feat with a Wright biplane.

Aerial Postal Service in England.—The English Postmaster-General has arranged for the inauguration of the "First United Kingdom Aerial Post" in London on September 9th. The aerial mail will be collected from special letter boxes located in several department stores. It will be taken by automobile to the Hendon aerodrome, whence an aeroplane will carry it to Windsor Castle in less than half an hour. From the post office at Windsor Park the letters will be sent in the regular way to all parts of the world.

Flying in a Wind.—Perfect mastery of their machines in half a gale by the Curtiss aviators, Beachy, Ely and Ward, and the ability to fly and climb to great heights when even the Wright machines were unable on account of the wind, was the surprise of the Chicago and Boston meets. At the former Beachy and Ward flew high and long—the former attaining and altitude of 7,017 feet and flying till his fuel was exhausted—when five Wright machines remained on *terra firma*, while at Boston Beachy and Ely made fine flights after the 23-mile race to the lighthouse and back had been postponed on account of the wind.

Aviation in the Sahara.—The French government is pushing forward its plans for providing communication by aeroplanes in the Sahara, especially for military purposes. In accordance with the recommendation of the military committee of the Ligue National Aérienne, and of General Bailloud, commanding the 19th army corps, a post for aeronautical studies will be established in the autumn of 1911 at Biskra, 140 miles from the coast. Particulars of this enterprise have been published in *La Nature*, from which it appears that five aeroplanes will be provided, four of them to be of metal, in anticipation of the fact that wooden apparatus would be seriously warped by the hot climate. The staff will consist of three aviators, under the command of Lieut de Lafargue, and thirty other men (mechanicians, etc.)

A New Record for the Michelin Cup.—Competition remains for the Michelin Trophy, which is to be awarded this year for the longest continuous flight over a 62-mile circuit. Stops are permissible to take on fuel, etc., the thing that counts being the distance covered from the start to the finish of the attempt. On the 9th of last month Vedrines set out to fly 1,000 kilometers (starting at 4 03 A M, he flew until 3 P M on his Morane monoplane, covering 811 2 kilometers (503¾ miles) of which 800 kilometers (496.8 miles) count as the record. The time, including two 50-minute stops, was 10 56'42, and the average speed 57¾ miles an hour. On the 26th ult. M. Helles, in a 15-hour flight, covered 1,200 kilometers (745.6 miles) on a Nieuport monoplane that averaged 50 miles an hour including stops.

Recent Altitude Records.—Beginning with the record height of 3,300 meters (10,826 feet) scored by Capt Felix a month ago, a number of altitude records have been made with and without a passenger. Capt Felix, who flies a Blériot, made his record when practising for a flight across the Alps. On the 4th ult., in France, Lieut. Biard started from Mourmelon with a passenger and attained a height of 2,000 meters (6,560 feet) over Sissonnes. The same day, in England, Olivet de Montalent reached 2,500 meters (8,200 feet) with a passenger. On the last day of the Chicago meet Lincoln Beachy broke the world's altitude record by climbing to a height of 3,548 meters (11,640 feet) in one hour and 48 minutes. He attained this great height in a Curtiss "headless" biplane, and thrilled the spectators by a daring descent in spirals after his gasoline was exhausted. Beachy's actual height above sea level was 12,296 feet.

Science

Prof. Tarr's Adventures in Alaska.—According to press dispatches, Prof. Ralph E. Tarr, of Cornell University, who has been studying Alaskan glaciers, lost all of his data and instruments when a skiff, in which he and his party were crossing the delta at Fairbanks, capsized.

The German Antarctic Expedition.—The "Deutschland," the ship of the German Antarctic Expedition, which sailed from Germany in May, is expected to reach Buenos Aires in September. A leisurely voyage has been made over parts of the Atlantic that have hitherto been little explored in a scientific way, and oceanographic and physical observations have been carried on. Lieut. Filchner, the commander of the expedition, will join the ship at Buenos Aires, together with the last part of the equipment, including the ponies and dogs.

An International Museum of Speleology is to be founded at Adelsburg, Austria, near which lies the Adelsburg Grotto, the largest known cavern of Europe, the passages of which are five and one-half miles long. In this museum will be collected objects of all kinds relating to the study of subterranean botany, zoology, paleontology, anthropology, as well as geophysics, underground waters, etc. The site, which is in the famous Karst country, is well chosen for the purpose. The Austrian Ministry of Agriculture has contributed $6,000 to the undertaking.

A New Aerotechnic Institution.—Notwithstanding the fact that the word "aerotechnic" is not yet known to the dictionaries, institutions devoted to aerotechnic investigations are springing up in all parts of the world. The latest addition to the list is the Aerotechnic Institute, near Versailles, founded by M. Deutsch de la Meurthe, which, we learn from *Nature*, was formally opened on July 6. It has been endowed by its founder with a capital of $100,000 and a yearly income of $8,000, and is equipped with all apparatus necessary for experiments in aeronautics and aviation.

Why American Prairies are Treeless.—Prof B. Shimek, of the State University of Iowa, has been studying this question in Iowa, where the treeless prairie originally covered more than seven-eighths of the total area of the State. He finds that the absence of trees is not due primarily to the soil or the topography, nor to such causes as prairie fires, the former abundance of the bison, etc., but is an effect of climate. Moreover, it is not due to a deficient rainfall, so much as to an excessive rate of evaporation. "The prairie areas are uniformly so situated that they are fully exposed to the factors which cause rapid evaporation, namely, the sun and the wind. During much of the year they may present conditions quite favorable to plant growth, but there are seasons and there are portions of the year, especially in midsummer, when evaporation and consequent desiccation become so extreme that only those plants which are especially adapted to dry regions can survive."

Petrified Forest Giants.—Three petrified redwood trees, that have been pronounced the very largest in the world—that have thus far been discovered—have just been uncovered from the débris of the mountain-side—only a short distance from the famous Bohemian Club Grove, in Sonoma County, Cal. This point is near the little town of Occident. One of these prehistoric monsters—that make the pyramids of Egypt modern, by comparison, in their ages, measures 23 feet in diameter and is 350 feet in length! The other two petrified trees are 18 and 12 feet in diameter, respectively. The very largest petrified trees yet discovered, near Calistoga, Sonoma County, Cal., is only 12 feet in diameter. These three trees lie on a wooded hill pointing due north and south. The petrifaction is most remarkable—the grain of the wood, and in one of them the decaying heat, being very plainly discernible. Surrounding these petrified trees is standing a forest of very large redwoods. However, all of the standing trees are dead. The owner of the land on which these three great petrifactions lie, is now having the débris all cleared away, so as to fully expose the giant trunks, and an iron railing will protect them.

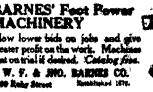


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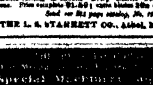
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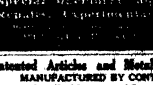
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Electricity

Connecting England and Belgium by Telephone.—Arrangements have been made to lay a submarine telephone cable across the English Channel to connect England with Belgium. The length of the cable will be close to 50 miles. It will be provided with Pupin coils, and the construction will be similar to the cable now connecting France with England.

Wireless on Turkish Warships.—A wireless telegraph station is soon to be built at Constantinople. This will have a capacity of twenty kilowatts, and a radius of six hundred miles. In connection with this station, eleven Turkish warships will be equipped with apparatus covering a radius of four hundred miles, and seven others will be equipped with less powerful apparatus.

A Monorail Elevated Road for Mexico City.—A corporation is seeking permission to build an elevated railway in the Federal District, Mexico, on the plan of the one in Berlin, where the cars hang from a single rail It is proposed to build a loop or circle within the city proper, by which passengers will be carried to within three blocks of almost any part of the capital, and from this loop branches will extend to the suburbs The branch lines will run at ground level after leaving the city.

Wireless Telegraphy in Morocco.—A wireless telegraph station recently installed at Fez has greatly facilitated communication between the French government and its troops in Morocco Messages are sent from the Eiffel Tower in Paris to Oran, Algeria, and there relayed to Fez Another wireless telegraph station has been established by the French at Taourirt This furnishes an alternate means of communication between Paris and Fez, viz., by submarine cable to Oran, by overland telegraph to Taourirt, and by wireless to Fez.

Electric Baling Presses.—It has been an almost universal practice to operate baling presses by hydraulic power This has entailed considerable expense in localities where water pressure could not readily be obtained. It was recently suggested that electricity could be used to advantage for this purpose Presses of this sort are now in operation The table which carries the bale is suspended by means of four steel cables from the press head. The cables pass over several sheaves, to the winding drum which is connected to a reversible motor By this means the table is pulled up toward the press head, compressing the bale An automatic brake is provided for holding the bale under pressure.

Wireless in Military Aviation.—On July 29th the new wireless outfit of the French military aviators was used with entire success in an aeroplane manned by Adjutant Ménard, as pilot, and Lieut. Brenot, according to a note in *Cosmos* The aviators started from St Cyr and flew over the region of Rambouillet. Keeping at an altitude of 1,600 feet, they had no difficulty in sending wireless messages to the Eiffel Tower, at an average distance of thirty miles, whence the messages were immediately transmitted to the Ministry of War The apparatus used weighs, in all, 48 pounds The spark is produced by a magneto operated by the motor of the aeroplane The antenna, made of steel wire, can be rolled up when not in use. Experiments are now being made with a view to increasing the range of transmission

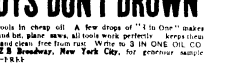
Wireless "Lighthouses."—*La Nature* announces that the French Ministry of Public Works has decided to establish three "phares hertziens" The transition of this expression into English involves a contradiction; a "phare" is a lighthouse, but the new installations are to utilise Hertzian waves in lieu of light, and are designed to take the place of ordinary lighthouses in time of fog. One will be established at the lighthouse of Créach, Ushant; one on the island of Sein; and the third on the lightship "Le Havre," seven miles from the cape of La Hève. Each of these three "lighthouses" will send a characteristic signal By the use of the Bellini-Tosi radio-compass vessels will be able to determine the direction from which the signal comes, and thus get their bearings in thick weather.

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¶ This is a practical treatise, based on Dr. Max Maercker's "Introduction to Distillation" as revised by Drs. Delbrück and Lange. It contains new materials, making, working and yeast preparation, fermentation, distillation, rectification and purification of alcohol, alcoholometry, the value and significance of a test-free alcohol, methods of denaturation, its utilization for light, heat and power production, a statistical review and the United States law. The is one of the most authoritative books issued on the subject and is based upon the researches and writings of the most eminent of Germany's specialists in the business of fermentation and distillation. It covers the manufacture of alcohol from the raw material to the final rectified and purified product, including chapters on denaturing, domestic and commercial utilization
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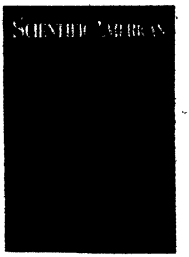
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Industrial Chemistry

The September Magazine Number of the SCIENTIFIC AMERICAN issue of September 16th, 1911



In the Scientific American for September 16th, the debt of humanity to the chemist will be set forth in simple language by men of the highest authority. No book of fairy tales ever told a story more amazing than that of modern industrial chemistry.

Just now one of the most puzzling of Nature's laboratory secrets has yielded to the patient research of the chemist. Rubber can actually be made artificially. But the product is more precious than diamonds. Will artificial rubber ever be a commercial possibility? This subject is discussed by Ira Remsen, President of Johns Hopkins University, in simple non-technical language.

A surprising laxity has been shown in this country in the matter of buying raw materials. Fortunately, we are waking up to the fact that enormous savings may be made if such materials are subjected to thorough tests. On this subject Dr. Charles F. McKenna, a leading expert, has prepared an interesting article.

America can point with pride to its achievements in electrochemistry. What the chemist can do with the aid of electric energy is told by William H. Walker, Professor of Chemistry at the Massachusetts Institute of Technology.

The opportunities for achievement offered by Industrial Chemistry will be discussed by Robert Kennedy Duncan, Professor of Industrial Chemistry at the Universities of Pittsburgh and Kansas. He will also give valuable advice to young men who wish to enter this field.

Dr. Allan Rogers, of Pratt Institute, is going to explain how he trains men to become foremen in works employing chemical processes, thus making for an intelligent cooperation with the expert chemist.

The familiar platinum sponge igniter for gas jets represents one of the infinitely numerous examples of so-called contact action of catalysis. Of the significance of this phenomenon and the mystery still surrounding it, which science has as yet been unable to dispel, Mr. A. J. Lotka writes in a specially prepared article.

MODERN ALCHEMY



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More important than the quest for the Philosopher's stone is the aim of modern science toward the making of perfect steel.

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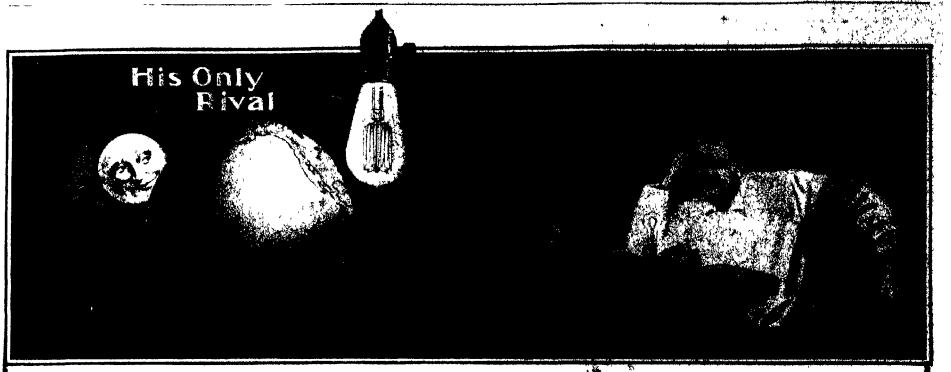
STRENGTH. Combined with nickel or chromium or both, Vanadium makes the most rational, strong steel known. By rational is meant a steel that is strong without being brittle, resilient without weakness, hard without being refractory, close grained, tough, and subject to accurate modification by suitable heat treatment.

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Thirty-two years ago the Wizard of Menlo Park dreamed his great dream which has now come true—Electric Light for Everybody.

Edison's Dream Comes True

When Edison invented the electric incandescent lamp thousands journeyed to Menlo Park to see "the light that burned without air."

Edison put a little paper horseshoe filament, that he had carbonized, into a glass bulb and pumped out the air. Next he passed a current of electricity through this horseshoe.

The Dream

It glowed white hot, lighting up the darkened room, another light glowed in his face, for he saw the revolution that tiny bulb would bring about in the world's useless hours.

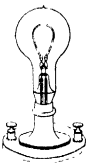
But the first lamps of 16 candlepower used up 100 watts of electricity.

Slowly, as improvements came, the amount of light was increased. Six years ago people thought the limit was reached, for the close of the first quarter-century of Electric lighting was celebrated by the advent of the Edison Gem lamp. Using the same amount of electricity, it gave more than twice the light of that first wonderful lamp.

The Revolution

Suddenly another invention in electric lamps revealed the dawn of a new era in electric lighting—unseen in the dreams of anyone—except Edison.

This was the Tungsten filament lamp which instead of the original 16 candlepower—or the fancied limit of 40 candlepower—gave actually 80 candles of light from the same 100 watts.



Edison's Original Lamp Invented 32 Years Ago



Latest Edison Mazda Lamp with Non-fragile Filament

This lamp almost materialized the Dream—but the filament was brittle—and the cost was high.

Both these obstacles are now cleared away. First, a brilliant invention has resulted in the production of a drawn wire stronger than steel. This wire is used to make the filaments in Edison Mazda lamps.

The filament or "burner" in Edison Mazda lamps is so sturdy that hundreds of thousands are in use under severe and trying conditions, even for lighting railway trains and automobiles.

Next—of prime importance—the full advantage of the General Electric Company's reduced cost of manufacture has been given to the public.

And the present price of the perfected Edison Mazda lamp is about one-half that of the first, brittle tungsten lamp.

The Dream Comes True

So, with lower cost and a better lamp, Edison's dream of the Sun's Only Rival has come true. The waiting millions can be served now that electric light costs so little and does so much.

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SIXTY-SEVENTH YEAR

SCIENTIFIC AMERICAN

THE WEEKLY JOURNAL OF PRACTICAL INFORMATION

VOLUME CV. NUMBER 12.] NEW YORK, SEPTEMBER 16, 1911 [10 CENTS A COPY $3.00 A YEAR



Courtesy *Metallurgical and Chemical Engineering.*

Charging an electric furnace with molten metal.



Electric steel furnace tipped to pour out its charge.

How Electricity is Aiding the Chemist

Some Principles Underlying the Application of Electricity to Chemistry

By Prof. William H. Walker, Massachusetts Institute of Technology

RAW material and energy, these are the two essential factors which go to make up every industrial chemical process. With the exception of the rare gases of the atmosphere, every object around us is susceptible of chemical change, and hence available to a greater or less extent as raw material for some chemical process. The possibilities of the chemist are in this direction unlimited. The second factor, energy, was for many years supplied almost exclusively in the form of heat derived from the combustion of some kind of fuel, and thus limited in many ways the chemist's activity. It is only within the last quarter of a century that there has been supplied to the manufacturer in commercial quantities, a new form of energy, namely, electricity. With the development of powerful electric generators harnessed to great sources of water power there has been rendered available a form of energy destined to play an important part in the industrial development of the country. When chemical change is brought about by the application of electric energy, we have an electrochemical process, and the art is called electrochemistry.

It would have little value simply to catalogue the many successful applications of electrochemistry which have been worked out, or to describe the great industrial plants based on electrochemical processes which have grown up in America within the last decade. Rather we will attempt to point out some of the principles underlying the application of electricity to chemical industry, and to give a few examples illustrative of each general class.

Electric Conductance and Decomposition.—When a chemical substance such as common salt or blue vitriol is dissolved in water, it is, for the most part broken up or separated into electrically charged atoms or groups of atoms called ions. When a current of electricity from some external source is led into such a solution, it is transported through the solution by these ions. At the points where the current enters and leaves the solution (i. e., the electrodes) these ions are deposited and take from the current the electrical energy necessary to change them into the corresponding elements or compounds. Thus when an electric current is passed through a solution of blue vitriol (copper sulphate) metallic copper separates out where the current leaves the bath, and sulphuric acid is formed at the other, or entering, electrode. This ability of the electric current to decompose chemical compounds into their constituent parts is called electrolysis, and forms the basis of many important industries.

Electrolysis of Salt.—Common salt, sodium chloride, is one of the cheapest as well as one of the most important of our chemical raw materials. From it through intricate and expensive processes there has been made for centuries the caustic soda and soda ash used in a hundred industries, such as the manufacture of glass, soap and textiles. At the same time from this salt by another complicated process the bleaching powder of commerce was produced. Electrochemistry has changed all this. At present by simply passing a heavy current of electricity through a strong salt solution, caustic soda is produced and drawn off at one electrode, and chlorine gas, which when absorbed by common lime makes bleaching powder, is evolved at the other. Compared with the older processes, this electrolytic one is simplicity itself. Although there are many millions of dollars invested in the old processes the time is rapidly coming when they must give way to the new.

In a very similar way, namely, by passing a current of electricity through a hot solution of potassium chloride (the "muriate" of commerce) and allowing the two products formed at the electrodes to react on each other, is formed the potassium chlorate used in such large quantities in making all kinds of matches. This electrolytic process is carried on at a number of places in the United States and has entirely superseded the old method of making this important chemical.

Refining of Metals.—On this same principle depends the enormously important industry of the electrolytic refining of copper, by which during last year alone something over $100,000,000 worth of pure copper was prepared for the market, besides the recovery of several millions dollars' worth of silver and gold from the waste. The crude or raw copper is cast into slabs which are made the entering electrode (anode) for a heavy electric current passing through a copper sulphate solution. Pure copper is deposited from the copper sulphate solution on a very thin sheet of pure copper which forms the outgoing electrode (cathode), while the sulphuric acid set free dissolves from the crude copper electrode an amount of metallic copper equivalent to the pure copper deposited upon the cathode. The supply of copper sulphate solution is thus kept constant. By maintaining the conditions within certain limits the current is selective in its action, transporting only the pure copper from the crude slab or ingot over to the other electrode where it appears as chemically pure metal. Similar methods are used for refining other metals such as silver, etc.

Metal Plating.—All electro plating is done by the use of the electric method just described. If we imagine the impure metal anode replaced by a pure metal one, be it of copper, nickel, silver or gold, and the cathode sheet replaced by the object to be electro-plated, we have reproduced a plating bath. Objects of great size such as tubing and conduit pipes are now covered with zinc in this way. Electrotyping is but a variation of the same process.

Metallic Aluminium and Sodium.—Certain molten compounds have the property of conducting the electric current and of breading up at the electrodes just as salts in water solution do. Of special importance in this connection and depending upon this fact is the preparation of the metals sodium, magnesium and aluminium. When a current is passed through molten caustic soda for example this compound is broken up the metallic sodium separating at the cathode and the remainder of the molecule, oxygen and water vapor passing out into the air. The molten sodium is cast into ingots and preserved under petroleum oil. It is of great use to the chemist and is now made at about one-fourth the cost of what it could formerly be produced for by strictly chemical means.

But of much greater importance is the manufacture of aluminium, a metal more abundant than iron, and especially noted for its lightness and silver like appearance. For many years chemists had searched for a cheap method for producing aluminium inasmuch as it is more abundant on the earth's surface than any other metal, and although the price had been reduced from five dollars per pound it could not be made by chemical

(Continued on page [illegible])

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The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are sharp, the articles novel, and the facts authentic, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

The purpose of this journal is to record accurately and in simple terms, the world's progress in scientific knowledge and industrial achievement. It seeks to present this information in a form so readable and readily understood, as to set forth and emphasize the inherent charm and fascination of science.

The Coming International Congress of Applied Chemistry

AT the time of the Columbian Exposition at Chicago in 1893, two hundred chemists of various nationalities convened at the invitation of the American Chemical Society and the World's Congress Auxiliary. So successful was this meeting that it was decided to establish a triennial international congress. Accordingly, the following year the first International Congress of Applied Chemistry was held in Brussels. Since that time, at intervals of two and three years, the Congress has convened at Paris, Vienna, Paris, Berlin, Rome and London. The Seventh Congress held in London in 1909 was attended by four thousand one hundred members, 985 papers were presented and the final report of the Congress occupied over four thousand pages in print. The Eighth International Congress is to be held in this country next year, the opening meeting being in Washington, while the Congress proper will hold sessions in New York.

The outcome of these international meetings has been to establish uniform standards and to solve many problems of international importance. At the last Congress thirteen topics were proposed to be reported upon at the next Congress. Some of these questions relate to the unification of methods of food analysis, the unification of terms for reporting analytical results of soils, fertilizers, and ash, the establishment of a central bureau for fermentation organisms, the question of securing greater uniformity in the commercial supplies of potent drugs, the conservation of natural resources, etc.

Probably the report on the international patent question will be of greatest interest because it involves the problem of secrecy versus patents in industrial chemistry. It is hoped that a general discussion of this problem will lead to a closer affiliation of the manufacturer with educational centers. Were the theoretical chemist of the university laboratory permitted to enter the commercial laboratory and plant, incalculable benefits would result. It is so easy in chemical operations to keep a process secret that there has not been much incentive to expose methods under protection of patents. In fact it would be impossible to secure patent protection on some important processes. As a consequence our professors of chemistry find it difficult and well nigh impossible to keep abreast of the times as regards commercial practice. The men they teach are not sufficiently prepared to enter the field of commercial activity by reason of the barriers erected by manufacturers in the path of the instructors of chemistry. It is greatly to be hoped that some way may be found of solving this problem, as it would undoubtedly result in raising this nation to a higher plane in the field of chemical activity. In Germany, for instance, many university professors are employed as consulting experts in large chemical works. Thus they are brought into closer touch with practical applications of chemical principles which accounts in part for Germany's premier position in the field of applied chemistry.

The Eighth Congress will evidently take up matters of interest not only to the chemist but to the general public as well. To stimulate popular interest, four simplified science lectures will be given by representative men of different nationalities.

The committee in charge of the Congress is now concerned with the formulating of rules to govern the proceedings. A set of twenty-two suggested rules has been published, and an invitation is extended to anyone interested in the matter to criticise the rules before the first of December next. These rules apply particularly to those who are to take an active part in the Congress, and relate chiefly to the presentation and publication of papers. In order to avoid the confusion that has existed before, it is specified that papers must be prepared for this Congress exclusively, and must not be read at any previous meeting, or be published in any periodicals before the Congress convenes, and at no time may a paper be published elsewhere without giving credit to the Congress. The papers must be in the hands of the committee before June 30th, 1912, in order to be published and distributed at the meetings. Altogether the arrangements made by the committee seem to be of a very direct and practical nature, which should contribute largely to the success of the Congress.

Our Consular representatives have been active in stimulating interest among chemists abroad, with very gratifying results. A number of affiliated associations expect to meet with the Congress, and hence an unusually large gathering is assured. Aside from the direct benefits to chemists, exceptional commercial advantages should be presented by reason of the fact that many leading representatives of foreign manufacturers will attend. The opportunity should not be ignored of advertising the advantages of New York city as a manufacturing distributing center, and thus encouraging the establishment of branch manufacturing plants in and about this neighborhood.

Dr. Albrecht Kossel

DR. ALBRECHT KOSSEL, professor of physiology at the University of Heidelberg, has arrived in our country, on invitation from Johns Hopkins University, to deliver a course of lectures on "The Chemical Constituents and the Physiological Rôle of Proteids." With the fact that Dr. Kossel received the Nobel Prize in medicine for 1910, most of us reach the limit of our information about this very interesting man, although it would seem that a work deserving of such high distinction in the field of medicine should appeal to a large portion of the lay public.

Professor Kossel's work is much more subtle and more far-reaching than producing a new remedy for some old disease, or devising a painless system for administering drugs. His work has to do with discovering the nature of certain groups of atoms that make living cells do the many wonderful things that are so intimately connected with *living*. And it is because we may well hope that as a result of this work we shall be enabled to control the chemical activities of cells that are not behaving normally, that the specialized study of "proteids" is so important for medicine.

The analysis of the living body as far as the "cell" was completed over seventy years ago. Later the kernel of living matter or "nucleus" was the focus of attention as the seat of the "vital" cell activities, and then this was further dissected with the improvement in the mechanical and the chemical technique of microscopic research, so that certain special organs within the nucleus became the objects of much questioning and speculation among biologists. These are the so-called "chromosomes." So far the scientists had to deal with things that *could be seen*. Beyond that point the microscope could not help, in applying the methods that led from the molecule to the atom and then shattered the atom. Professor Kossel was a pioneer. For many years he has been working on the chemistry of the complex substances that are present in cell-nuclei and that seem to have a close relation to the growth of protoplasm. The "nuclein" isolated from cells by Miescher in 1871, turns out to be a whole series of compounds that are characterized by possessing an albumen base and a nucleic acid radicle. These Kossel identified with the "chromatin substance of the student of cells. On the basis of his work Malfatti and Lilienthal showed why the different cell constituents reacted so differently with anilin dyes, the basic dyes combining with "proteids" in the cell in proportion to the amount of phosphorus present—but the amount of phosphorus meant the amount of nucleic acid.

By very delicate methods of digestion with ferments, acids and alkalies Kossel succeeded in isolating a number of these "nucleins" and even produced one synthetically—not indeed from the "elements," but from such relatively simple compounds that his theory of the constitution of the nucleins is abundantly confirmed. The biological application of his analyses and synthoses is that the nucleins play the leading rôle in the growth of protoplasm inasmuch as the acid portion of the nuclein is capable of combining with itself an indefinite number of albumen molecules, later to split them off again to become a part of the living protoplasm, while the acid portion keeps on assimilating new material. Instead of the chromatin, for example, having a constant composition, the proportion of acid and albumen is constantly changing, according to varying conditions. The work is extremely specialised, but of tremendous importance: it will furnish the raw material for results of great practical importance, as well as of theoretical significance.

The Legend of the Rain-tree

DURING the last few months American newspapers have revived the well-worn tale of the "Peruvian rain-tree," which affords protection against drought. The leaves of this tree are said to have the property of condensing atmospheric moisture in large quantities and precipitating it in the form of rain. According to one writer, "the water falls from the leaves and oozes from the trunk and forms veritable rivers, which can be led as irrigating canals to any point desired. Making liberal allowance for evaporation and infiltration, a square mile grove of the trees would supply for distribution about 100,000 gallons of water daily."

On the strength of similar stories one of the trees to which the name "rain-tree" has been most often applied, viz., *Albizzia* (or *Pithecolobium*) *Saman*, has lately been exploited and sold extensively in Australia. The virtues claimed for it have proved to be altogether illusory, although it is useful as a shade-tree, and is widely planted for this purpose in semi-tropical and tropical countries.

The legend of the "rain-tree" or "raining-tree" dates back to the stories of the Fortunate Isles, where no rain fell from the skies and the soil was refreshed by the moisture shed by a tree of the sort described. The early navigators brought home stories of similar trees in the East Indies, in Guinea, Brazil, etc. The Peruvian rain-tree appears to have been brought to the notice of the world by the reports of a United States consul in Peru, about 1877. These reports were widely quoted at the time, and led the government of India to seek information on the subject from the authorities of Kew Gardens. The investigations of W. T. Thistleton Dyer brought to light a plausible explanation of at least a part of the rain-tree stories.

The traveler Spruce reported his own experiences with the rain-tree as follows:

"The Tamia-caspi, or rain-tree of the eastern Peruvian Andes, is not a myth, but a fact, although not exactly in the way popular rumor has lately presented it. I first witnessed the phenomenon in September, 1855, when residing at Tarapoto. I had gone one morning at daybreak, with two assistants, into the adjacent wooded hills to botanise. A little after seven o'clock we came under a lowish spreading tree, from which with a perfectly clear sky overhead a smart rain was falling. A glance upward showed a multitude of cicadas sucking the juices of the tender young branches and leaves, and squirting forth slender streams of limpid fluid."

This is not the only explanation. That many plants spontaneously exude moisture under suitable conditions is well known. The phenomenon is called "guttation," and has perhaps been most fully described by A. Burgerstein in his work "Die Transpiration der Pflanzen" (Jena, 1904). The moisture drawn up from the roots of plants most frequently passes off into the air in a gaseous form; i. e., by transpiration. If the air is saturated with moisture, and if the supply of moisture to the roots is copious, then liquid drops will be exuded sometimes in large quantities. Molisch records a case in which a single leaf of a species of *Colocasia* gave off 190 drops per minute. Burgerstein gives a list of 241 plants, belonging to 101 families, in which guttation has been observed.

This process goes on chiefly at night, and in cloudy and foggy weather; i.e., when the relative humidity of the air is highest. It is altogether probable that in the moister parts of the tropics there are trees which exhibit this phenomenon in such a degree that the name "rain-tree" may be fittingly applied to them. It is, however, certain that no such process can occur in a dry climate, and that the proposal to plant the rain-tree as a panacea against drought is entirely chimerical.

Artificial Rubber

Another of Nature's Laboratory Secrets Unmasked

By Ira Remsen, President of Johns Hopkins University

ABOUT forty years ago two young chemists announced that they had succeeded in making enough indigo to be pretty sure they had it. The method used by them was entirely independent of the indigo plants. The yield was extremely small and there seemed to be no promise in the method of future commercial success. A quarter of a century later or thereabout the manufacturer was supplying the world with artificial indigo and the occupation of the indigo planter, if not gone, was going. And now the chemical world is all agog over rubber. Last year a specimen of artificial rubber was exhibited at Berlin identical in all its properties with the natural substance. At present there appears, to be sure, to be little prospect of early commercial success along the line suggested, but the results already reached are of such interest as to incite to many efforts to solve the problem.

First a few words concerning rubber. This substance is obtained mainly from South and Central America, though, of late years, owing to the great increase in the demand for it, plantations have been started, especially in Ceylon and the Malay Peninsula and Archipelago, and these are now contributing to the world's supply. In 1909 the production of rubber is stated to have been 70,000 tons. It is obtained from various trees as *Hevea brasiliensis, Manihot Glaziovii, Castilloa elastica, Funtumia elastica, Ficus elastica, Hancornia speciosa*, etc. Deep incisions are made near the base of the tree. The liquid flowing from these incisions is heated to drive off most of the water and the residue is the impure rubber of the market. The valuable constituent is caoutchouc, a colorless, elastic, amorphous substance. This has long been known but little has been learned in regard to its chemical nature until recently.

In general terms it may be stated that chemists do not like to work with gummy substances, but prefer things that crystallize, or that boil without decomposition, or that form definite crystallizable products. Now caoutchouc does not crystallize, it does not boil without decomposition, and until a *few years* ago it was not known to be capable of yielding definite crystallizable products. Great impetus was given to its study by the discovery of Harries that it forms a well-defined product when treated with ozone, and that the ozonide thus obtained decomposes when boiled with water and yields levulinic aldehyde, a substance that can easily be identified.

It has also been shown that caoutchouc forms a so-called nitrosite when treated with nitrous acid, and this nitrosite can also easily be identified. These facts make it possible for the chemist to tell whether he has caoutchouc in hand or not and the scientific study of the substance has been materially advanced in consequence. Before the discovery of these facts a product had been obtained artificially that was described as "like rubber," but the question whether it was identical with caoutchouc or not could not be definitely answered. Now it is possible to determine with certainty whether a substance is or is not caoutchouc.

To identify caoutchouc after you get it is one thing, to determine what it is is quite another. The first step towards the solution of this problem was taken a number of years ago when Greville Williams showed that when rubber is heated to decomposition a very volatile substance is formed which he called "isoprene." This boils at 36 deg. C. and is a hydrocarbon of the formula C_5H_8. Later Harries found that this same hydrocarbon is formed by the action of moderate heat upon oil of turpentine and other terpenes. This isoprene has come to be the chief factor in the artificial preparation of rubber, for it is this substance which when exposed to certain conditions is converted at least partly into caoutchouc.

That isoprene readily undergoes change was observed by Tilden who announced in 1892 that one of the products is caoutchouc. Later he stated that contact with strong acids as, for example, aqueous hydrochloric acid, causes the change of isoprene into caoutchouc, at least to a small extent. Still later he claims to have discovered that isoprene is changed to caoutchouc spontaneously. He says: "Specimens of isoprene were made from several terpenes in the course of my work, and some of them I have preserved. I was surprised a few weeks ago at finding the contents of the bottle containing isoprene from turpentine entirely changed in appearance. In place of a limpid, colorless liquid, the bottle contained a dense syrup in which were floating several large masses of a solid of a yellowish color. Upon examination, this turned out to be India rubber."

Harries tried to repeat Tilden's work, but although he kept at it for seven years he was unable to confirm his results. He says: "Tilden must therefore accidentally have hit upon conditions which caused the polymerization of the isoprene, but, and this is the main point, he did not furnish the proof that he really had produced caoutchouc." Klages had previously publicly stated that it is impossible to produce caoutchouc by the method suggested by Tilden. This was the state of affairs as far as the chemical public was concerned until the summer of 1909. Then Harries received from an English firm a specimen of a substance which it was claimed had been made artificially by a process patented by Dr Heinemann in England. Harries found that the substance was in fact caoutchouc, but he did not believe that it had been made artificially. Heinemann's method consisted in passing acetylene, ethylene, and methyl chloride together through a tube heated to redness. Harries could not make this work and others who tried it also failed.

Up to this time the experiences of Harries had been anything but encouraging. In November, 1909, he received from the Elberfeld Color Factory some specimens of artificial rubber which had been made from isoprene by a secret process devised by Dr Fritz Hofmann. This led Harries to take up his own experiments on the subject again, and toward the end of January, 1910, he was in a position to apply for a patent. The method devised by him consists in heating isoprene with strong acetic acid in a closed tube. The product thus obtained is unquestionably caoutchouc.

From the scientific point of view the problem of the artificial preparation of caoutchouc is thus solved, but it is a far cry from this to commercial success. Given isoprene in sufficient quantity and at a sufficiently low price and the commercial problem will be solved. At present artificial rubber is almost as precious as the diamond, but, on the whole, the problem is in a more hopeful state than the indigo problem was for years after the start was made. The manufacturers and those who are carrying on chemical investigations for them are plainly of the opinion that the work is worth while. That great firm, the Baden Aniline and Soda Factory (generally called the "Badische") has taken out a number of patents in this field, and this is most significant. It is this firm that worked out the indigo problem and is now supplying the world with artificial indigo, having expended in the preliminary work millions of dollars! It is this firm that is placing the manufacture of artificial nitrates upon a firm scientific basis—probably the most important problem before the world as it involves ultimately the food supply. It may safely be predicted that before many years have passed rubber will be artificially prepared in quantity sufficient to supply the great and increasing demand for it. Meantime there is no danger of a famine as plantations are springing up to supplement the supply of wild rubber.

As has been pointed out the first thing to be done is to get enough cheap isoprene. The only way to do this that appears to be in the least promising is to make it from oil of turpentine. The chief constituent of this oil is a terpene of the composition $C_{10}H_{16}$, while isoprene has the composition C_5H_8. The immediate problem, therefore, is to break down the molecule of the terpene, $C_{10}H_{16}$, into simpler molecules of the composition, C_5H_8. If this could be done easily and cheaply the rubber problem would be solved. In this connection it is of interest to note that, according to an article that has just come to hand, Staudinger and Kleven have succeeded in increasing the yield of isoprene obtained from the terpene, dipentene, by heating to a high temperature the vapor of the terpene under diminished pressure. When the pressure is sufficiently low the yield is about 60 per cent. This is a very important observation for the purpose in view. Dipentene itself does not, to be sure, occur in nature in very large quantity, but the chief constituent of American oil of turpentine is pinene, a substance of the same composition as dipentene, and pinene is converted into dipentene by heating it to 250 to 270 deg. C. The way out may therefore be through turpentine. To recapitulate, turpentine contains pinene. Pinene is converted into dipentene by moderate heat. Dipentene when heated to a high temperature under diminished pressure yields isoprene. Isoprene can be converted into caoutchouc by heating it with concentrated acetic acid and by other methods that need not be described here.

There are other hydrocarbons similar to isoprene that undergo changes similar to that by which isoprene is converted into caoutchouc, and there is therefore a prospect of the ultimate preparation of a number of products similar to rubber but differing from it in some respects. The commercial instinct has already led to the patenting of some of the processes involved. This aspect of the subject is, however, or it appears to be, of much less importance than the main problem briefly presented in this article.

In the chemical laboratories connected with the great factories, especially in Germany, where several hundred well trained chemists are frequently engaged in a single factory, no doubt much work is now in progress which has for its object the solution of the artificial rubber problem. This is also true of laboratories not connected with the factories. From time to time an article will appear in a scientific journal or a patent will be announced giving some result of the work. As usual, of the failures and disappointments which always far outnumber the successes we shall hear very little. But some day we shall wake up to learn that artificial rubber is on the market and then we shall be told truly that scientific research has scored another brilliant success. In the eyes of the world success will mean *commercial* success. But it must not be forgotten that this, if and when attained will be based upon innumerable results that have absolutely no commercial significance. Greville Williams heated rubber and obtained isoprene many years ago. No one dreamed at the time that this simple fact might ultimately become the basis of a great industry. Harries treated caoutchouc with ozone and founded a method for identifying caoutchouc which has proved of fundamental value in all subsequent work on this subject. We want to know what caoutchouc is, whether any one ever devises a method for making it artificially or not and in the highest sense the knowledge will be just as valuable whether such a method results or not. But that is another story.

Arrangement of Laboratory Supplies

By William P. Munger

IN an industrial laboratory, containing some 1,500 bottles of chemicals, it is no small job to keep even the chemicals in order. The helpers upon whom the restoration of the bottles to their places devolves usually have little skill and less interest in things chemical. When the chemicals are arranged by the usual alphabetic method, reagents are mostly found, and only then after prolonged search in just the place they ought not to be. Owing to the vast difference in size of bottles, to get any efficiency out of shelf space, it is necessary to have at least two or three alphabets, and when the search is completed through one, the others must be searched.

To overcome these obstacles to speedy work, the following system was recently worked out in one industrial laboratory: The contents were first roughly grouped as to size, and then as to nature of contents. Beginning on the upper and lower shelves, the containers were placed in rows from front to back. The upper left row was numbered 0-9, the second row 10-19, the third row 20-29, etc. The last figure on the front bottle always being 0 and if the shelf did not accommodate 10 bottles from front to rear then the numbers corresponding to the missing bottles were omitted, the next row beginning with the next higher ten. An alphabetical and numerical index was then compiled, giving a little description of the chemical in each bottle (such as C. P. Sticks, commercial powder) and typewritten copies made.

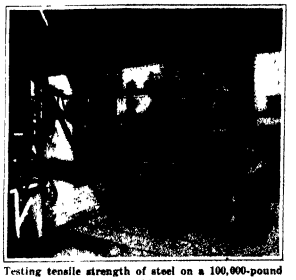
When a given chemical is wanted, a reference to the index is essential, but a glance shows what form it is in, and the bottle of that chemical best suited to the work in hand can be at once selected. Further, if a helper, although it may be his first day in the laboratory, is sent after a reagent and given a number, readily found, instead of an unfamiliar chemical name, the chances are greatly improved of his bringing back what was desired. When the reagents are to be replaced they are much more readily replaced in their correct positions by the method even by skilled workers.

This method is of wide applicability to medium sized stocks of articles, varying in size and use but not in name, such as motor and motor parts construction material, switches, insulators, patterns, etc.

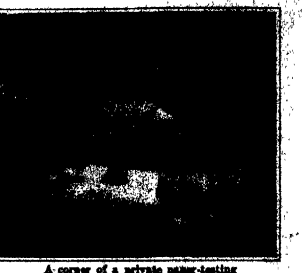
Testing Before Buying

The Economics and Aesthetics of Materials

By Dr. Charles F. McKenna



Testing tensile strength of steel on a 100,000-pound machine.



A corner of a private paper-testing laboratory.

THE simplicity and directness of aim observed in the choice of materials in the old arts and crafts have always elicited the admiration of thoughtful men and the wonder of curious ones. Consider, for example, how animal glue so happily answers the needs of the joiner for uniting two pieces of wood, how easily it can be treated and how perfectly it shows both tenacity and adhesion. This valuable and complex substance was known to the Egyptians, and they are said to have left on record descriptions of how to prepare it of best quality.

As to the metals we can understand that the ancient artificers, once they became acquainted with the different ones, perhaps by accidental smelting, should avail themselves of such obviously valuable aids, thus also of wood and of stone for building materials, but there are many other substances whereof the choice is remarkably discerning and apt, strongly suggesting that it was preceded by much patient investigation and keen observation.

Was it some clay worker making bricks for building who discovered that soft clay might be written upon and then burned as tiles to make imperishable historical records? Who first observed the silk worm and learned how to unwind the cocoon, strengthen the thread and weave cloth from it to make the garments of the rich? The ancients knew how to mat wool fibers together and make felt. They must have understood that the character of the surface of this fiber is unlike that of others and why it makes felting. Those ancient craftsmen evidently possessed a spirit which was eager for research and experiment and which overcame many difficulties of isolation and poverty.

Modern times can point to triumphs of its technologists in the similar search for suitable materials to apply in the arts. But the needs now are broader by the very fact of our greater resources to draw from and our vastly larger fields of activities. It becomes necessary for us to develop a much greater devotion to research into the properties and adaptations of materials. We cannot be contented with our present knowledge. We must have a larger variety of materials than we are yet acquainted with if we are to advance in the arts of construction, transportation, agriculture and manufactures. We need also a better acquaintance with those we have if we are to use them to best advantage and equal the older craftsmen in aptness of choice.

The uncovering of a new product or the application of newly discovered properties of an old one has possibilities for adding to the wealth of nations which can hardly be estimated.

The extraction of oil from cotton seed, an industry which did not exist before the civil war, has now reached a production valued at one hundred million dollars annually.

The virtue that lies in carefully selecting and compounding cement materials before calcining them at a high heat rather than taking them at random and burning at low temperatures has, in twenty years lapse of time, given us the Portland cement industry totaling seventy million dollars annually, and has almost extinguished the natural cement industry which produced not more than a twentieth of this in its best year.

The industry of manufacturing dynamite has grown till more than fifteen million dollars worth are manufactured annually. What will be the corresponding value when this powerful agency has been made safer by the lowering of the freezing point of nitroglycerin and by other stabilizing improvements and shall be introduced into agriculture for the breaking up of subsoil, clearing of forests, and draining of swamps?

Lastly we must exercise a control over all materials we purchase, examining them critically both to determine suitability and to appraise the market value.

Engineering, which now involves so much more than was meant by the term a generation ago, is more concerned than ever over the qualities of materials which are offered to it. In attempting to determine these it finds itself in need of resorting to instrumental means of manifesting differences in properties in order that fallible human judgment may be eliminated as much as possible. The movement began by demands for the preparation and preservation for duplication of the standards of weight and measure. Railway engineering was insistently calling for a deeper study of iron and steel. This resulted in a most intimate investigation of the chemical constitution of steel and brought about at the same time the development of machines and apparatus for observing almost all the physical qualities of materials. Later years have brought us demands of the same nature, not only from the constructional arts but also from every branch of manufacturing. The practice of the art of testing now includes the chemical, physical and mechanical studies of all kinds of iron, steel, copper, alloys, stone, cement, clay, coals, paper, paint, rubber, wood, textiles and a host of materials used in technology.



Determining the heat value of fuel.



The machine on the table was used in testing much of the cement used in the Brooklyn Bridge towers. In the foreground is a portable hydraulic cement-testing machine.

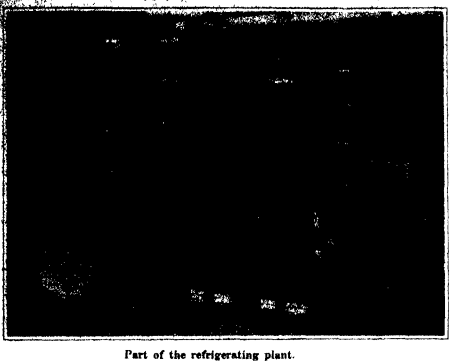
Out of this has grown a larger development of the governmental agencies which were established only as repositories of the standards of measures such as was originally the case with the Conservatoire des Arts et Metiers in Paris. Many nations endowed scientific stations for the applications of precision measurements. The Imperial Physical Technical Institute of Charlottenberg, near Berlin, is one of these, and is the most important and valuable standardizing laboratory in the world. It is composed of two departments, one dealing with the standards of measurement and obtaining correct data as to physical forces, the other dealing with determinations of the accuracy of technical instruments submitted for the purpose and to be absorbed in their turn into use as standards in other laboratories. A staff of more than one hundred experts and assistants is entirely supported by the government for this purpose. United with this is the Royal Material Testing Bureau of Gross Lichterfelde, whose object is to apply results of research directly to technical problems and routine testing of materials. It has the following departments: 1, metal testing; 2, building material testing; 3, paper and textile testing; 4, metallography; 5, general chemistry; 6, oil testing. It employs over two hundred persons and makes many thousand tests annually in these departments. Thus the co-relation of research and technical interpretation can be adjusted nicely under the guidance of the most skilled and patient investigators that the realm affords. France, Austria and England have institutions of like aim.

We are now abreast of the world in this important application of science, for our Bureau of Standards in Washington, founded by Act of Congress of 1901, has been operating for several years under the able direction of Dr. S. W. Stratton, and has made many valuable contributions to the literature of the science of exact measurement. Congress has continued to provide generously for the maintenance and extension of this work. Regarding the value of the chemical departments of the bureau, Dr. Stratton has said: "The relation of the chemical work to that of the other sections of the bureau is exceedingly important. Scarcely a problem can be taken up concerning construction or the properties of materials that does not involve chemical analyses or the co-operation and advice of expert chemists. The entire work of the bureau has been greatly strengthened and its efficiency increased by the organization of the work in chemistry."

A new section has been organized to provide for the routine testing required by the departments in making their purchases of supplies.

Perhaps the most prominent organization under one head availing itself of chemical examination and testing of all its supplies is the Isthmian Canal Commission, since its work constitutes the largest piece of construction and the largest housekeeping proposition that have ever been combined. As this calls for an expenditure of $300,000,000 within a decade, it can be seen that the supplies of materials are an important factor and demand close scrutiny.

These methods are applied by the Commission and the Purchasing Agents' office is concerned over the quality of the bronze wire bought for mosquito screens just as it is over the Portland cement which will be required for the dams and locks. It wants to know the composition and strength of the steel used in constructions, the Babbitt metal used in engine bearings, the dynamite used in blasting, and so on through a thousand things as diverse. This is on the very correct theory that the United States should get full value for everything it purchases, small or large.



Part of the refrigerating plant.



Shop for making and repairing instruments

Besides these government laboratories there are many others in this country which practice chemical and physical testing of materials for determining their qualities and values. Some of the largest of them are operated by the railroad companies, and quite a number by the great manufacturing corporations. In the latter case some concern themselves only with their own product, some with all the materials they purchase, and some have departments adapted solely to research into the properties of materials, applying the results to their factory practice.

In all the large centers of population and manufacturing are to be found laboratories where the needs of commerce for the testing of materials can be met. The same great variety of substances and fabrics are submitted to the chemists and physicists on their staffs, who are frequently appealed to for the decision of important questions. Yet in the application of material testing to the industries one meets at times a marked indifference to its economic advantages. This is the more curious since there are so many cases where they are obvious and so many where successful manufacturers testify to the importance to them of upholding this arm of efficiency.

They know that in many raw materials entering into the manufacture the presence of an adulterant or an inert substance carries a greater penalty than the mere payment for the useless element. The factory and handling charges accumulate against it just as if it was a valuable element and the output of finished material is reduced.

If, for example, one wishes to neutralize acid solutions with lime and employs an impure lime instead of a pure one, he will use more of it and he will be obliged to dispose of more sludge, possibly carrying with it absorbed valuable substances. If one uses a coal whose fuel value measured in heat units, is less than that of a coal used by a competitor he will likely feel the difference, not alone in his coal bills, but in his labor items for stoking and for disposal of refuse.

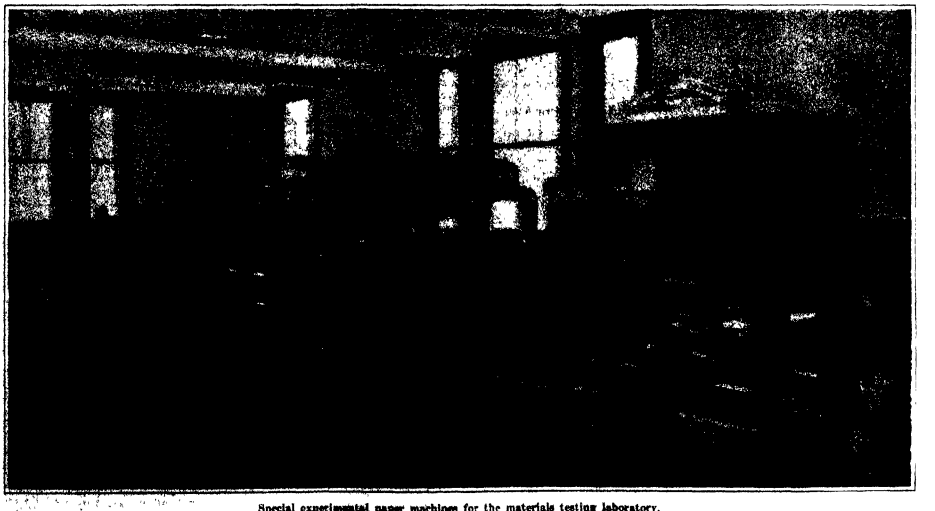


United States standard of mass—kilogramme.

The manufacture of silk fabrics furnishes another example. One would think that any manager using in large quantities as his chief raw material a substance more costly per pound than coal is per ton would be solicitous to keep exact record of the moisture in the lots he would buy that he might know their absolute dry weight, or "conditioned weight," so called.

Yet in the case of raw silk as used in this country we see something remarkable. 20,387,327 pounds worth $65,424,784, were imported into this country in 1909-1910. Special trains flew across the continent at high speed to bring the Japanese importations from San Francisco to New York city. So valuable was this raw material that a gain in interest and insurance was made by this haste. Yet only 1,298,709 pounds were officially "conditioned" for moisture or examined for other non-silk substances at the silk association's laboratory in New York city during the same period. Of course some silk manufacturers have their own silk conditioning laboratories but they are very few. Moreover these figures are confronted with the statistics of conditioning in Europe where consumption of raw silk is rapidly being approached by that of America. In the Milan conditioning house in

(Continued on page 250)



Special experimental paper machines for the materials testing laboratory.

SOME VIEWS OF MACHINERY USED IN THE LABORATORIES OF THE U. S. BUREAU OF STANDARDS

Catalysis

Its Mystery and Its Significance for Life and Industry

By Alfred J. Lotka

CATALYSIS or catalytic action has been somewhat variously defined. To give a rigid definition in simple terms is difficult, or perhaps impossible, and it therefore preferable in an article of this kind to describe the phenomenon, rather than to attempt to define it.

It is for various reasons, advisable to follow Ostwald in grouping together under the general heading of Catalysis two types of action, which perhaps at first sight may not appear very closely related, and which we may speak of as physical and chemical catalysis respectively. The feature which is common to both is that they occur in unstable (technically "metastable") systems. One or two examples will make this plain. By carefully observing certain precautions water may be cooled below 0 deg. C. (32 deg. F.) without solidifying. In this state the system is unstable. Introduce a minute crystal of ice, and immediately a growth of this solid phase spreads out from the crystal "germ" with which the water has been "inoculated." This effect of the ice crystal in bringing about the change from water to ice is an example of what was spoken of above as physical catalysis. Instances of this kind might be multiplied, but one will suffice for our needs. The facts which we want to notice, as being particularly characteristic of this "catalytic" action exerted by the germ introduced are:

1. The amount of water which can be caused to solidify by the introduction of the ice crystal stands in no relation to the size of the crystal. A given small crystal is capable under suitable circumstances, of causing the freezing of an unlimited quantity of water.

2. The result that can be produced by the "germ" is absolutely limited to the establishment of the stabler (frozen) condition, from the less stable (liquid) state. The ice crystal would be quite incapable of producing, under the stated conditions, the opposite change, namely, the melting of the ice. This might be expressed in popular language by saying that what the catalyser does, is merely to help on a change which is "trying" to take place also in its absence.

We shall have a few more words to say of physical catalysis further on, but what has been said so far may serve as a basis which will enable us better to appreciate the nature of "chemical" catalysis. It is a matter of very common observation, that a chemical reaction which proceeds with difficulty or (seemingly) not at all on merely bringing together the substances consumed in the transformation, takes place with greater or less ease—sometimes tumultuously—as soon as a small quantity of some suitable material is added. This itself appears to take no part in the transformation, judging from the fact that it can be recovered unchanged from the resulting products of the action. This chemical catalysis, as the effect is called, presents the same peculiarities which we noted above with regard to physical catalysis.

1. A small amount of the catalyzer is capable of causing the chemical transformation of an indefinitely large amount of material (though in practice there is necessarily some loss of the catalyzer through various secondary causes, such as the impossibility of completely separating it from the products).

2. The action of the catalyzer is strictly limited to the establishment of a "stabler" condition from a "less stable," or, in other words, a catalyzer can only produce or encourage such a net[1] reaction as brings the reacting system nearer to its equilibrium, and never, under any circumstances, the reverse. In the case of a chemical reaction we may deduce from this second rule a third. For we may state the second rule in this form: "A catalyzer is powerless to alter the equilibrium of a chemical reaction."[2] Since a chemical equilibrium is a condition in which two opposing reactions are going on at the same velocity it follows immediately that:

3. If a catalyzer accelerates one of a pair of equilibrium reactions, it must accelerate the other in exactly the same proportion.

These, then, are the fundamental facts relating to catalysis. It is very natural to ask: "How — by what mechanism — does the catalyzer exert its effect?" To this question we can give at best but a very imperfect answer. We shall do well to be guided in our attempt by keeping constantly before our mind's eye the fundamental facts related above. A mechanical model will best serve to illustrate the nature of the case. We may liken the supercooled water — ready at any instant to freeze on introduction of an ice crystal — or the mixture of $SO_2 + O$ — ready to unite (say at 500 deg. C.) to SO_3 as soon as it comes in contact with finely-divided platinum — to a liquid contained in a bowl at an elevated level. Popularly speaking, the liquid is "trying" to flow to a lower level, and will in fact do so as soon as *a suitable path* is furnished, either by making a hole through the side of the vessel, or by carrying a syphon over the edge of the bowl. Once we have done the small amount of work required to start the flow, we can derive an unlimited amount of energy from the outflowing liquid, since the bowl may have any dimensions whatever without affecting our argument. What prevents the liquid from flowing down from the bowl, is that before it can descend it must ascend, or, in technical terms, in order to pass from a point of higher potential to one of lower, it would have to travel over a path passing through points of still higher potential than the starting point. This would be contrary to the physical laws applicable to the case under consideration.

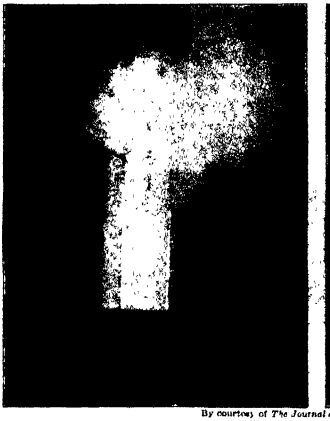
In the same way we may suppose, that the molecules of SO_2 and O are tending to unite to form molecules of SO_3; all but a small proportion of them however are prevented from so doing by the fact that, in the course of the change, they would have to pass through intermediate states "on the crest of the hill," before they could take their downward path to the more stable condition.

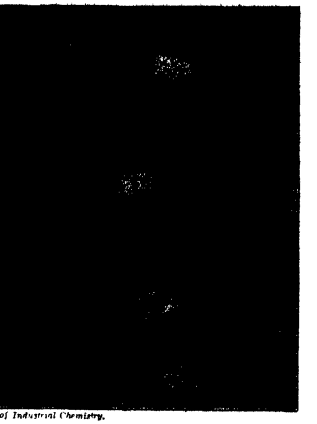
When we come to consider the exact manner in which the catalyzer furnishes this new path, we find ourselves in difficulties. In some cases at least a partial explanation can be given. For example, if the reaction takes place between gases, as in the case $SO_2 + O \rightarrow SO_3$, the action of a finely-divided material, such as spongy platinum, may perhaps be accounted for by the fact that gases tend to form a film of greater concentration near the surface of a solid. Such increased concentration might explain an increased reaction velocity. In other cases it has been shown that in the presence of the catalyzer the reaction takes place in two stages, each stage singly being more rapid than the net reaction in the absence of the catalyzer. But these are at best partial explanations, applicable to isolated instances of a phenomenon which is extremely common, and indeed, probably universal. The cause of the mystery which still enshrouds catalytic action is not far to seek. It is closely connected with the fact that our knowledge of chemical action is almost wholly restricted to the initial and final states. Of the processes which intervene between the instant when a molecule of one compound ceases to exist as such, and the moment when the molecule of the product is completely formed, of these processes we know practically nothing. Referring to this subject, Schönbein[3] has remarked: "Shakespeare says that 'there are more things in heaven and earth than are dreamt of in philosophy.' Thus, presumably, intermediate between the state in which two portions of matter exist after completion of chemical combination, and the state in which they previously existed separately, there is a series of transition states of which the chemistry of to-day knows nothing." With all the advances which chemistry has made since Schönbein wrote these words, they still remain true almost to the letter.[4] So long as we are left in our present ignorance of those states of matter which intervene between the initial and final states in "chemical change," it is very unlikely that we shall be able to form an adequate idea of the nature and inner meaning of catalysis.

So much for the facts and theories of catalysis. Now for its bearing upon technical and vital processes.

From a theoretical point of view it is a somewhat disputed question whether a catalyzer can start a reaction, the German chemist Ostwald holding that it can merely accelerate a reaction, which would go on, however slowly, in its absence also. For practical purposes, this the distinction is of no interest, for a reaction which took thousands of years to become noticeable would be quite worthless and might as well be said not to take place at all. Generally speaking, the function of a catalyzer in technical practice is not only to speed up a reaction, but to render it industrially possible at all. Nevertheless, it may be interesting briefly to consider the economic effect of catalytic *acceleration* upon the process. Suppose that under given conditions one ton of raw material and material in the course of transformation must be locked up in the process, in order to produce a daily output of, say, one ton of the product. With all other conditions unchanged, let us now suppose that by the introduction of a suitable catalyzer the reaction velocities are just doubled. If we require an output of one ton, as before, we can now reduce our plant to the

(Continued on page 255.)





By courtesy of *The Journal of Industrial Chemistry.*

The current is turned off, and dense acid fumes issue from the apparatus.

On establishing the electric field, there is practically perfect condensation of the fumes.

CONDENSING ACID MIST BY ELECTRICITY

[1] By "net" reaction is here meant the resultant of two opposing reactions, in case we have to deal with a "reversible" reaction.

[2] This does not apply to "stationary states" such as occur in certain light reactions. They are not true equilibria.

[3] *Journal. prakt. Chemie*, volume 38, 1, 199.

[4] We may, perhaps, however hope for new light on these questions from the recent work of Max Trautz.

The Industrial Chemist

What Opportunities for Achievement are Offered Him

By Robert Kennedy Duncan, Professor of Industrial Chemistry at the Universities of Pittsburgh and Kansas

To many men, and the parents of so many men, who are interested in modern science read the SCIENTIFIC AMERICAN that one is tempted to take the opportunity of this special number on Industrial Chemistry for some intimate discussion on the invitation which this science extends. What is Industrial Chemistry, how may one become an industrial chemist, and what opportunities for achievement does it offer? The writer is prompted to this because in his positional capacity he is this year at the receipt of an unprecedented and altogether un-looked-for number of inquiries and personal visits from men and their parents who are just as ignorant of this matter as they are interested. These inquiries arise through the vague, but entirely valid, idea that there are some remarkable contemporary opportunities in Industrial Chemistry.

Leaving for the nonce the nature and scope of these opportunities, let us settle the meaning of the term—What is an industrial chemist? The fact is that "the industrial chemist" and the training he ought to have, is to-day a subject of warm debate among those of us who follow applied chemistry. As is usual in such discussions, the trouble-factor lies in our varying definitions. To one man, an industrial chemist is a chemical engineer, to another, he is a "works chemist," to a third, he is a routine analyst, to a fourth, a scientific researcher, and so on. There are thus many types of industrial chemistry, and many kinds of each type and each kind with its own allure. Industrial Chemists are all alike in this, however, that they are interested in applying chemical knowledge to practical and useful ends. The industrial measure of what is practical and useful is the dollar, and the only material difference between Pure Chemistry and Industrial Chemistry is that with the industrial Chemist the dollar sign inevitably enters into every chemical equation; a subordinate difference is that many industrial chemical reactions are carried out by the ton instead of by the gramme.

How, then, is one to become an industrial chemist? Obviously, by learning Chemistry. An industrial chemist may have some knowledge of engineering, or of biology, or, for that matter, of psychology (all the better if he has), but the *sine qua non* is Chemistry. Chemistry is Chemistry, and since it is *quite* impossible to obtain it self-taught, the novice must enter some institution of learning for the requisite training. It is just at this point that he needs guidance.

If the young man is too old to undergo the school-training that would enable him to matriculate into one of the higher institutions of learning, if he has responsibilities, such as the support of mother and sisters, that would make it inadmissible for him to proceed in his own interest, or if he recognises that he is not so endowed intellectually that he could expect to survive creditably in the severe class-room and laboratory training that university-chemistry infers, then by all means let him enter a trade-school. He could not do better, in fact, than to enter *for* a training the scope and character of which is presented in this number by Prof. Allen Rogers, of Pratt Institute. Nor would he by so doing cut himself off from a genuine success. The industries are in point of fact desperately in need of scientific foremen; i. e., of men educated in chemistry and mechanics to an extent that enables them to co-operate sympathetically and practically with the officials of the company for the elimination of waste and for progressive factory practice; in addition, educated foremen may become superintendents, and superintendents managers, and managers presidents.

But if, on the contrary, the man concerned is interested in chemistry for its own sake, if he eagerly desires to become, genuinely, a scholar in chemistry fully equipped to add to the world's sum of knowledge both pure and applied, and if he has none of the hampering ments stated above, then his course may be as follows:

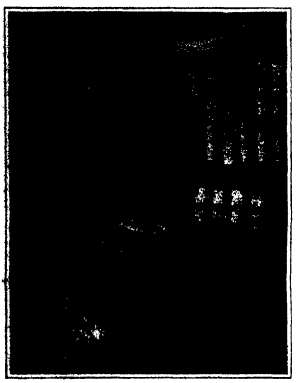
Before stating this, however, there ought to be said that any man proposing to become an industrial chemist should satisfy himself that when he is ready for work he will be able to qualify under the following demands:

(1) Training (scholarship).
(2) Creative power.
(3) Practical integrity.
(4) Physical health.
(5) Personality; i. e., executive power under the control of common sense.
(6) The ability to govern workmen and to manage foremen.
(7) Personal qualities that would commend him to the officials of the company.

From this list it may easily be imagined that industrial chemistry is no game for old ladies or for little children.

Granted, however, that the man feels that he can fulfil these requisites, he has alternative courses.

He may enter the course in industrial chemistry in any one of the great universities or institutes of technology. In such a course, he will receive, together with a general theoretical and practical survey of the different fields of industrial chemistry, a considerable amount of pure chemistry, some engineering, shop practice, factory law, etc. Such a course in industrial chemistry, admirable in its scope and purpose, is offered by Prof. Whitaker, of Columbia University. The result of such a training is likely to be a man well trained up to his limits, hard-headed, practical and of great ultimate use to the factory which he enters in installing or managing the chemical end of an industrial plant—decidedly, in fact, a man that knows



Robert Kennedy Duncan

what he knows. The danger is that having been trained in *multa*, not *multum*, he may have a wrong conception as to his immediate use in such a factory; and since it is impossible under such conditions to give a comprehensive chemical training in a course of four years, he is likely always to be limited in his power to apply contemporary discovery to practical ends. Still, the industries need, and, indeed, must have men of this very type, and there is now and in the future there will be for them a continuous acceleration of demand. If the man concerned, through his natural qualities, desires to do this kind of thing, this is the kind of thing he desires to do—and there is as much opportunity for him as he could well desire.

The alternative course advises the man to enter the university carefully prepared to forget that he is pursuing to become an industrial chemist, but instead of that, in a comprehensive way, a *chemist*. His course is to take all the chemistry that the curriculum prescribes or permits, and with it what other cognate or cultural study his time affords.

His course will require some four years of undergraduate study followed by two or three years of graduate study. At the end of this time, if he is the young man I take him to be, as a young doctor of philosophy indorsed by his university, he is prepared to take and can obtain an industrial position. He may enter this position without any pretense of knowledge as to the processes involved, but he may take the writer's word for it that, other things being equal, he will speedily surpass competitors who have experienced the other forms of training; he will, in fact, have nothing to limit him in becoming a supreme authority in his chosen field. It may be suggested, that seven years of university training is a long and costly course. As for time, it is worth it; as for cost, in the case of a man for whom alone industrial chemistry would be worth while, it certainly does not require a rich father.

The ideal condition for the right kind of a man to enter the university assumes that his monetary resources do not exceed five cents, in other words, the price of a car-fare to get there. In the University of Kansas, thirty per cent of the students make their way, in whole, through the university, and sixty per cent in part. There is no man to-day worth his salt who cannot, depending solely upon himself, make his way through the university to the appointed end.

After passing through whatever training the man's circumstances or inclinations dictate, he may enter various types of industrial work, in which his training equally with his other qualities will determine whether or not he will stick or advance.

(1) Routine Analysis—Such positions are filled for the most part by young men with but a modicum of chemical training or by chemists who have a particular liking for that type of work. Salaries for men doing routine testing work vary from sixty to one hundred dollars a month, but may yield as high as two hundred and fifty dollars a month. Advancement depends mainly upon qualities that serve to qualify men for executive work. A large number of such positions are open to-day in all parts of the country—in general commercial laboratories, in manufacturing laboratories, pharmaceutical, metallurgical, beet-sugar laboratories, etc., sanitary laboratories, and in various other fields of effort. Such routine positions are particularly valuable for chemists in training, in providing temporary positions by which a supporting income may be obtained for collegiate expenses together with valuable experience.

(2) Government Positions—The Bureau of Chemistry, of Soils, and of Standards, of Mines, the Geological Survey, and various other branches of government constantly employ and are continually looking for skilled young chemists regularly graduated from the universities. While the salary stipends are not as great as the holders of these positions could for the most part obtain in industrial or even in instructional work, the positions themselves are exceedingly advantageous in confirming the training of the universities and in throwing the man into positions in field-work where initiative, self-reliance, fortitude and other manly qualities are developed. The danger related to such positions is that too long continuance in such work is likely to develop the chemist into a bureaucrat, sometimes of rather an offensive type. Chemical positions under government are good stepping-stones to desirable industrial positions. As is the case generally, the demand for good men in such positions far exceeds the supply. Apart from federal positions, all the States require and use many chemists in food, water, fuel, mining, criminal and other work.

(3) Works Chemists and Chemical Engineers—These positions are rapidly on the way to become some of the most attractive in the whole field of industrial chemistry. As a member of the Committee on Employment of the Chemists' Club of New York, it is interesting to watch the character of the applications that continually arise from the various industrial companies seeking chemists. For example, the following positions are open:

Chemist versed in the manufacture of vinegar.

High grade industrial chemist or research engineer; work upon copper, lead and tin alloys; explosives, etc.

Man needed to do work in connection with toilet articles.

Chemist for drug company.

Assistant chemist to manufacture complete line of tablets and pills.

An A No. 1 laboratory man for wholesale drug laboratory.

Man thoroughly trained in laboratory work; a good manufacturer of pharmaceutical products.

Man with practical experience in the U. S. Patent Office work.

Chemist to conduct investigations on the distillation of wood for turpentine.

Two men who have had experience in work on soils, feed and agricultural products.

Chemist and superintendent for sulphuric acid and alum plant.

Assistant chemist for pharmaceutical work.

Man needed experienced in varnishes, japans, and paints. Work of experimental character.

Analytical chemist for powder company.

Assistant organic research chemist of congenial personality; must be thoroughly trained in organic chemistry.

Instructor of junior and senior students practically entirely in chemical technology, engineering training required.

Chemist needed for the manufacture of ordinary pharmaceutical preparations.

Chemist for analytical work of a pharmaceutical laboratory including drug assaying.

For zinc and chemical company, man experienced in the manufacturing of sulphuric acid by the chamber process.

Chemist in oil laboratory.

Assistant chemist, fats, oils, analytical work.

(Continued on page 255)

Psychology and Advertising

The Scientific Appeal to Human Nature

By Edward L. Thorndike, Professor of Educational Psychology, Teachers College, Columbia University

PSYCHOLOGY is the science of human nature. Commercial advertising is the art of influencing human nature to buy certain wares. Advertisers are discovering that they need to know the facts which psychology can give about what attracts attention, what sticks in memory, what gives a pleasant impression, what persuades and what leads to a given act, here the act of purchase. Psychologists are learning that the responses of men and women to the illustrations and "copy" of ads are material for the scientific students pure curiosity about the workings of the mind as well as for the economist or expert in business. So a new specialization of applied psychology is fairly started, its birthday being perhaps that of the publication of Prof. Scott's "Psychology of Advertising" in 1903.

No matter which of the many problems that confront advertising practice you choose, you are soon led straight into psychology—often psychology of a very technical sort—if you try to think the problem through to the end. To make known a breakfast food or soap, to connect its name or appearance or both with the fact that it is a breakfast food or soap may seem an easy problem for common sense. Rufton's Soap in big enough type, on enough pages, fences, and cards the method of our childhood—is indeed straightforward and easily done. But common sense does not inform one whether an emblazoning *Rufton's Soap* on an eighth of a page eight times or on a whole page once, on a page alone or on a page with a picture, more surely captures attention and holds memory prisoner. It does not even distinguish between getting the human mind to think of "soap" when it happens to think of "Rufton's" and to think of "Rufton's" when it happens to think of soap. Yet this difference may mean thousands of dollars.

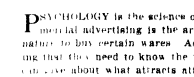


Fig. 1.—A strong claim on attention at small cost

Putting Facts Before the Mind.

Common sense has indeed often made great blunders, neglecting clearness, pleasurableness and habit as causes of attention and over-emphasizing size and repetition, the costliest ways of catching the eye and mind. Even to-day the elementary laws of attention taught to beginners in psychology are not always followed. For example no psychologist among my readers will doubt that Fig. 1 burns in its message, the name of an automobile, better than Fig. 2, and in a fraction of the space.



Fig. 2.—A weak appeal. Too elaborate, vague, and confused.

But the problem of putting a fact, or, more commonly, two facts in connection into a mind, leads soon to far more subtle and technical matters. I choose only one for illustration—the laws of the action of the eye, which is the first enemy for an advertisement to win over. The eye, in getting its impression of a page, a wall, or a billboard, acts roughly as would a small camera in getting a series of pictures which pasted together, would make a picture of the total page, wall or billboard. That is, the eye does not see clearly much at one time nor move in a continuous



Fig. 3.—Too big type is a common error. An unnecessarily hard task for the eye.

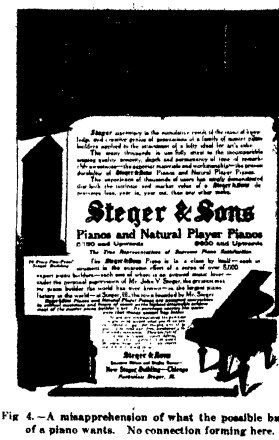


Fig. 4.—A misapprehension of what the possible buyer of a piano wants. No connection forming here.

sweep to cover the object. It turns, stops for one to three tenths of a second, takes in an "eyeful," turns ahead or back, stops as before, takes in another "eyeful," and so on.

Getting an Eyeful of Advertising.

Means have been found to photograph the movements of the eyes in reading a page, examining a picture and the like, and measurements have been made of just how much the eye and understanding do take in during one stop—one exposure of the camera. The reader who is conscious only of looking at an advertising page in a magazine for two seconds and getting a view of it as a whole, really takes a dozen or so different "looks." The eye itself can not see the whole page at all clearly in one look or fixation. The eye sends up a piece-meal report which has to be *put* together. The task of the eye in glancing over a page is a complex task which may be done well or ill, easily or with a feeling of strain.

The advertiser should, of course, other things being equal, (1) make the labor of the eye as slight as possible, (2) furnish any material that the eye is to take in at one glance or fixation in the shape of a convenient "eyeful," and (3) arrange the "eyefuls" that are to catch the eye in its series of exposures in such a way that the piecemeal report they give will be most sure to be put together into the impression he desires to leave.

To meet these requirements even the expert advertiser needs special knowledge of the psychology of visual perception. Common errors are to make type *too large*, as in Fig. 3, so that a single fixation fails to give any whole phrase or word, or to so crowd and muddle printed matter that the eye moves about the page at random. Less commonly the eye is actually tempted *away* from the essential facts in the display.

To get attention to an advertisement is only a first step in a long pursuit of the mind, which must be at last forced by the laws of its own nature to write for and read a catalogue, to examine an article, or, most commonly of all, to buy it.



Copyright 1917 by Keystone View Co.

Fig. 5A.

Intuitive Knowledge Supplemented by Psychology.

Experienced advertisers who have studied the results of many advertising campaigns get an intuitive appreciation of how men and women will be influenced by this, that and the other quality in an advertisement. Can such intuitions be usefully supplemented by the psychologist's knowledge of the laws of attention, perception, memory, suggestion, habit, inference and the like?

Let us ask, as a sample case, whether advertisers have anything to learn from one of the simplest of all psychological laws, a law of habit or connection formation, which states that a human being will, other things being equal, make to any situation that response which has gone with that situation most frequently, and with the most resulting satisfaction. Man thinks or feels or does what he has thought or felt or acted in like case with success. Will it profit an advertiser to think of the possible buyer as a mechanism that, whatever else it does, tends unreasoningly to keep together ideas that have come together?

This law leads to five obvious principles for controlling a person's mental connections.

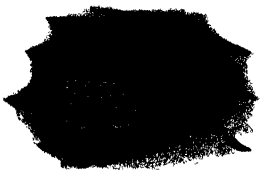
1. Know what his situation is.
2. Know what response you wish to get from him.
3. Know what satisfies or annoys him.
4. *Make* the connection, do not expect the response to *come as a miracle.*
5. Other things being equal, make no connections which you will later have to unmake.

That these principles, which should be the A, B, C of any art of influencing human nature, are not thoroughly known to advertisers, is clear from the following facts. Advertisements almost exclusively to arrest the attention of a casual observer (e. g., advertisements consisting of an interesting but largely irrelevant picture with a mere note of the article and firm name) are used for articles like seeds, doorknobs, nursery stock, or coffins. This is wasteful since possible buyers of such wares would in a great majority of cases make a deliberate examination of advertisements of them, the situation including much interest on their part and a definite intention of comparing merits. Advertisers who use expensive attention-arresting display for such articles *do not consider what the possible buyer's situation is.* Looking casually at a picture of a bon ami cake, he is not in the least likely to think of buying bon ami. He is not in the situation of wanting bon ami. He is not in the situation of wanting anything. He is not in the situation of wanting to buy anything. He is not in the situation of wanting to buy anything that he has not already decided to buy. He is not in the situation of wanting to buy anything that he has not already decided to buy and has not already bought. He is not in the situation of wanting to buy anything that he has not already decided to buy and has not already bought and has not already used. He is not in the situation of wanting to buy anything that he has not already decided to buy and has not already bought and has not already used and has not already liked. He is not in the situation of wanting to buy anything that he has not already decided to buy and has not already bought and has not already used and has not already liked and has not already recommended. 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daily over a magazine, looking to find where to buy a given article, and looking to find out which is the best article, are three radically different situations that obviously demand different treatment.

Getting the Right Kind of a Response.

Some advertisements are fitted to produce the response "readiness or desire to buy *a* motorboat, *a* piano, *a* greenhouse" as much as or more than the response "readiness or desire to buy *the Jones* motorboat, *the Smith* piano or *the Brown* greenhouse." The



The Easy-Made Dessert.

From the homely materials pictured here are produced desserts so beautiful and delicious that they appear to be the work of the fairies.

All that is required to make a Jell-O dessert is a package of

JELL-O

and a pint of boiling water. Dissolve the contents of the package in the boiling water. As soon as it is cold your dessert is made.

Just now, when the supply of canned fruit has given out, and it is too early for fresh fruit, the delicious fruit flavors of Jell-O fill their places and afford desserts that are especially seasonable and delightful.

The flavors are: Strawberry, Raspberry, Lemon, Orange, Cherry, Peach, Chocolate.

At all grocers', 10 cents a package.

Who shall do perfect manner glove use. Unconditional Promise Book, "Concerning the Well Woman," free.

THE GENESEE PURE FOOD CO., Le Roy, N. Y., and Bridgeburg, Can.



The Birthday Party.

Nan is six years old. Mamma and Bobbie are giving her a party. And what a dinner Mamma has prepared! Just now she is serving a Jell-O course, and there is no mistaking the children's approval. They all like

JELL-O

because it is delicious and beautiful. It is so pure, wholesome and nutritious that kids better for them than any other kind of dessert.

A Jell-O dessert can be made in a minute. Simply add boiling water and let cool.

Seven delicious flavors: Strawberry, Lemon, Orange, Raspberry, Peach, Cherry and Chocolate.

All grocers sell Jell-O, 10 cents a package.

Who Interesting new Jell-O Recipe Book, "Desserts of the World," illustrated in two colors and gold, sent for name of two grocers who sell Jell-O.

THE GENESEE PURE FOOD CO., Le Roy, N. Y., and Bridgeburg, Can.

Fig. 7. Samples from a series of advertisements that are in the main in accordance with psychological principles.

response which any competitor equally desires is confused with the response which the advertiser himself should seek. Certain features of many advertisements of automobiles, Portland cement, bathroom fittings and office furniture make this error. In some such cases a real profit-sharing of supposed competitors may be the reason, but even in such a case it is wasteful to encourage a response as beneficial to future competitors in the same trade as to the advertiser.

Neglect of the third rule, "Know what satisfies or annoys the prospective buyer in the case in question," is very common. Does not Fig. 4, for example, show a misapprehension of what the possible buyer of a piano wants? The pictures of the factories and office building seem psychologically fitted to appeal to a man to place a mortgage or perhaps invest in the company's stock, but not to appeal to the desires and aversions of a music-lover in respect to a piano. Are the pictures of the man and the hall-mat borders likely to connect the idea of a pure rich tone and of beautiful music with that particular piano? Would not the general make-up—the arrangement of cuts and type—positively irritate anyone of an artistic temperament?

The fourth rule—to make connections, not expect them to come of themselves—seems at first thought childish. But did the "Sunny Jim" "ads" connect a given breakfast food inevitably with ideas of delicacy, health and vigor, a diffuse the very name of that food with a charm for appetite, and bind to the sight of its package a strong impulsion toward purchase?

On the contrary, I venture to predict that many of my readers who remember Sunny Jim do not even remember what breakfast food was supposed to have made him sunny; and that many others have, as a result of the "ads," the hardly more valuable connection of thinking of the food in question as the subject of a vigorous advertising campaign, in connection with pictures and jingles about a rather ridiculous looking little old gentleman.

Making the Connection.

As a matter of fact, the greatest amount of psychological ingenuity is demanded to "make the connection," simple though it sounds. To connect the article and the name, to connect each *desirable* quality with the name, to connect that name with the ideas of purchase and possession—each may be a most intricate task, involving, like a problem in chess, the interpolations of dozens of factors. Disturb one adjective, focus one preparatory advertisement ineffective, overdo compliments in the picture, and the whole attack may fail.

I have willfully chosen samples of inadequacy from the best modern advertising practice, in order to make the point that violation of the psychological laws of closeness, relevance and concreteness are perilous to even the most expert writer of advertisements. For perfectly clear cases one may take those given by Prof. Scott of the picture of a breakfast food carton with vermin crawling over it, and of the underwear company which received many orders as a result of a second company's advertisement, the second company's "copy" having been so placed as to connect more readily with the first company's name and address than with its own.

The last warning, against making connections only to have to break them later, should protect any advertiser from many risks. For example, the emblem, slogan or means of attracting attention to the "copy" should not risk boring or disgusting readers in the long run for the sake of an exciting appeal for the time being. A history of advertising would, I am sure, prove that the grotesque the merely strange and the fantastic have been thus dangerous.

A psychologist would prefer not to risk his fortunes on the habits formed by repeated impressions of

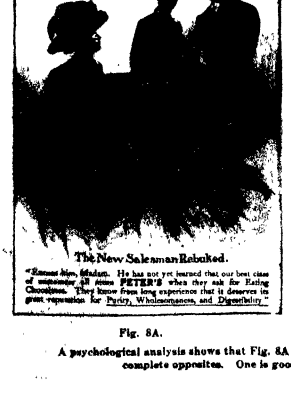
Come Packt furniture.
U All-No after-dinner mint
Slide Well collars.
Breathe-rite braces
Corn Dodger shoes
Holeproof hosiery.
Pre-Shrunk garments.

Yet these are all modern devices used to gain the trade of critical people.

The psychologist expects Fig. 5B to outlive Fig. 5A as a catch-sign, and predicts that even the charming chicken of Fig. 6, that "hasn't scratched yet," may in the long run bore the public and have to give up his place to the safer picture of the soap itself.

I have so far illustrated the value of knowledge of one sample law of human nature—a law of habit—by showing the bad effects of its neglect. On the positive side, I should claim that many of the excellencies of Fig. 7 could have been planned and can be accounted for by the psychological principles of association or connection forming.

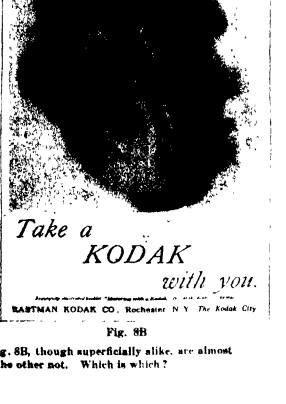
Finally, I have chosen two "ads," Fig. 8A and 8B, which superficially seem much alike but one of which I regard as very good and the other as very bad on purely psychological grounds. Let the reader decide which is which and why!



The New Salesman Rebuked.

"Remember him, Madam. He has not yet learned that our best class of customers all desire PETER'S when they ask for Eating Chocolates. They know from long experience that it deserves its great reputation for Purity, Wholesomeness, and Digestibility."

Fig. 8A.



Take a
KODAK
with you.

EASTMAN KODAK CO., Rochester N.Y. *The Kodak City*

Fig. 8B

A psychological analysis shows that Fig. 8A and Fig. 8B, though superficially alike, are almost complete opposites. One is good and the other not. Which is which?

Yeast as a Food

THE brewers of Germany produce annually over 70,000 tons of yeast, which is for the most part wasted. For several months there have been going on systematic experiments under the direction of Prof. Delbrück, of the Berlin Institute for Fermentation Industries, for the purpose of finding some practical means for utilizing this product. Special attention has been directed to the problem of its possible availability as human food.

There are a number of commercial preparations on the market which consist essentially of dried yeast, these combine the qualities necessary to adapt them to use as food, having an agreeable taste and odor and a chemical composition comparing favorably with other high protein foods. When properly prepared, dry yeast keeps indefinitely without danger of deterioration, and its high protein content would make it one of the cheapest foods. The slightly bitter taste characteristic of fresh yeast can be readily removed by treatment in the cold before drying, with a solution of sodium carbonate.

Messrs. Voetz and Baudrexel, of the Institute, have determined its adaptability to the nutrition of man and other animals. The chemical composition of the dried yeast, as compared with average samples of beef is given in the following table:

	Dry Yeast	Beef
Water	6.9%	72.5%
Protein	53.4%	21.0%
Calories per lb (approximate)	2,000	607

From the above it is seen that the protein value of the yeast is about two and a half times that of meat, and that the fuel value of the former is over three times that of meat.

Experiments made in feeding dogs showed that 87.2 per cent of the nitrogen in the yeast is assimilated. Large quantities of this material were used on the dogs without producing any symptoms of inconvenience or disorder. Among the animals were some females suckling their young, these seemed to thrive very well under the conditions of the experiment.

A number of the employees of the Institute replaced a portion of the meat in their diets with dry yeast powder using 2/3 ounce with each breakfast for several weeks. No unfavorable results were produced.

How Electricity Is Aiding the Chemist

(Continued from page 253.)

methods for less than one dollar per pound. In 1889 Mr. C. M. Hall discovered and perfected his electrolytic method by means of which aluminium can now be sold at less than twenty-five cents per pound. The oxide of aluminium, a cheap raw material, though insoluble in most solvents and infusible at ordinary temperatures dissolves in molten alkaline fluorides like sugar dissolves in water. From this molten solution the metal is separated by the passage of an electric current, and appears at one electrode while the oxygen is set free at the other. The use of aluminium where light weight and strength are desired as in automobile and aeroplane construction is well appreciated, and to its cheap production much of the success in these industries depends.

Heat From Electricity.—Although heat derived from electricity is very many times more expensive than heat obtained by the burning of ordinary fuels, there are two conditions which make electrically generated heat of great service to industrial chemistry. These are:

1. Heat generated within the zone of chemical reaction.

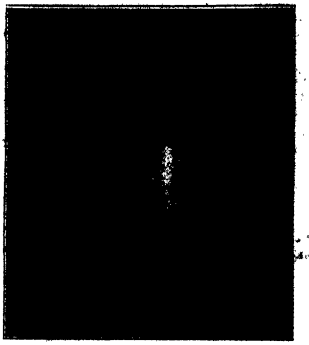
2. Heat generated at a temperature higher than that attainable by burning fuel.

1.—In the great majority of chemical reactions, owing to the necessity of carrying away the waste gases produced by combustion, the heat thus generated must be conducted through a containing wall to the material undergoing chemical action. Not only is this in itself wasteful of fuel, but frequently the high temperature necessary on the outside of the container is so destructive of the containing vessel as to render the cost of operation prohibitive. Since when an electric current passes through a conductor of high resistance great heat is generated in the conductor it is only necessary to place this conducter within the container in order to generate the heat at the point where it is needed. The walls of the container can thus be maintained at a much lower temperature than would otherwise be the case, which greatly prolongs their life.

An example of the use of electric heat generated within the reacting vessel is in the manufacture of phosphorus. Although it was known for many years that a mixture of sand, coke and bone-ash when highly heated would produce phosphorus, the reacting mass so soon destroyed the containing vessel as to render the process a failure. By passing a current between carbon electrodes in a firebrick furnace, and feeding the mixture in such a way that the walls of the furnace are constantly protected by some of the unacted upon charge, the process is made continuous and the cost of the material greatly reduced. All of the phosphorus of the great match companies is now made in this way.

Another example of the use of internal electric heating is in the manufacture of carbon-disulphide, a liquid used in large quantities in protecting wheat and other grain from the weevil. This chemical was formerly made by passing sulphur vapor over hot carbon in an iron retort. These retorts lasted so short a time, that the price of carbon-disulphide was never less than twenty-five cents per pound. By heating the carbon to incandescence by an electric current the retort may be replaced by a firebrick furnace of large size and the material made so cheaply that it is now sold for less than four cents per pound.

But by far the most important application of internal electric heating is in the manufacturing of steel. The older methods of making steel by the Bessemer and open hearth processes while capable of turning out an immense tonnage are both limited in the extent to which a steel free from dissolved gases, oxides and other undesirable constituents can be produced. The gases of combustion are always present to contaminate the product. When made by the so-called crucible method, in which an amount not over 100 pounds is melted in a graphite crucible, a high grade product is obtained, but the cost is necessarily high. By the application of the electric furnace to steel making a gap which has long existed will be filled and a steel better than the open hearth but cheaper than crucible steel will be offered the consumer. There are a number of types of furnaces in operation in both America and Europe, some having a capacity of fifteen tons. Doubtless the most important field for the electric furnace in the steel industry is as a finishing furnace for the Bessemer converter. This method is already in use in the United States and is apparently giving very promising results, combining, as it does, the very cheap preliminary refining in the Bessemer process with the perfect finishing condition of the electric furnace. The great usefulness of the electric furnace in the preparation of a high grade steel at moderate cost is only beginning to be realized.



Courtesy *Metallurgical and Chemical Engineering.*

Tapping a silicon furnace.

II.—The temperature attainable by the combustion of fuel is naturally limited to the dissociation temperature of the product of combustion; in other words, to the temperature where the carbon and hydrogen of the fuel will no longer combine with the oxygen of the air to generate more heat. This is approximately 2,000 deg. C. In the electric furnace the heat generated by the passage of the electric current is limited only by the amount of electric energy available, and the volatilization point of the material forming the conductor. Carbon does not break up until a temperature of about 3,700 deg. C. is reached, and hence a temperature of this hitherto unthinkable intensity may be realized.

With such an enormous temperature, or even much below this upper limit, many reactions are possible which do not take place at the maximum temperature attainable with fuel, and the working horizon of the chemist is thus greatly widened.

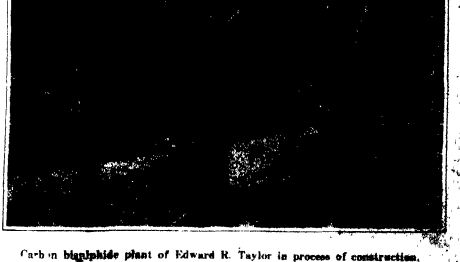
Calcium Carbide.—The great chemist Wöhler some fifty years ago made calcium carbide by melting metallic calcium and carbon, and generated from it the wonderfully brilliant illuminator, acetylene gas. But it was not until the advent of the electric furnace that calcium could be obtained direct from its ore, and then and calcium carbide produced in large quantities. It is made very simply by heating to a very high temperature a mixture of lime and coke, or other form of carbon. The product is tapped in the molten condition from the furnace much as is the case with cast iron. The magic of the electric furnace has transformed the dull and slow burning coke into a compound which with water yields a gas brim full of energy and capable of giving a light of the greatest brilliancy. A new use is developing for calcium carbide in the fixation of atmospheric nitrogen. The plant world might paraphrase the lament of the shipwrecked mariner and say "Millions of tons of nitrogen and not one pound to use." Although the air is 80 per cent nitrogen, it is not in a form available for plant growth. It has been found that when this nitrogen gas is passed over moderately heated calcium carbide, a union takes place, and a compound of calcium carbon and nitrogen called calcium cyanamide is formed. Under certain conditions this compound is a nitrogenous fertilizer and can be used instead of other forms of fixed nitrogen as a food for growing crops. A large plant for the manufacture of cyanamide has lately been finished at Niagara Falls, Canada.

Carborundum.—A second carbide, but one entirely different in its properties is known as carborundum. This is made by uniting silicon and carbon at a high temperature, and forms an exceedingly hard mass which is used as an abrasive, much as emery is used. A mixture of sand (oxide of silicon) and coke is placed around a resistor of carbon and highly heated. After the furnace has cooled a mass of beautiful crystals, brilliant in color and exceedingly hard, is found concentric with the carbon. This mass is pulverized and worked up into abrasive objects of all kinds and is known and used the world over. Again the magic of this intense heat has produced from common sand and coke, a mass of brilliantly beautiful crystals; a splendid butterfly from the common grub.

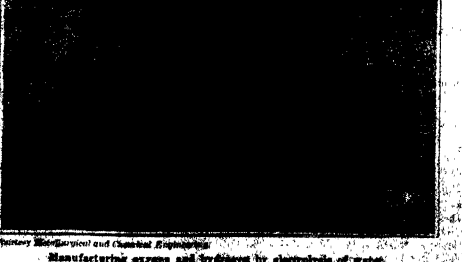
Graphite.—If in making carborundum the temperature is carried too high, instead of masses of the carbide of silicon there is found only the carbon constituent; but this is now in the form of graphite. This observation gave Mr. Acheson, the inventor of carborundum, a clue which when followed out produced what is universally known as Acheson graphite. Before this discovery we were dependent upon the graphite scales obtained from Ceylon and Siberia, which had to be laboriously worked up into the finished article. Now the article, whether it be a crucible, electrode or what not, is formed of coke and pitch, and when baked is intensely heated in an electric furnace when it is converted into the purest graphite. This method of forming graphite electrodes has been an inestimable boon to the entire electro-chemical profession and has been an important factor in the progress of the art.

Silicon.—Instead of reducing the silicon from sand (oxide of silicon) and then combining it with carbon to form carborundum, it has been found possible to so conduct the operation that the metal silicon is formed in large quantities. A few years ago the element was a curiosity, now it is made and marketed by the ton.

Space forbids extending the list of applications of electricity to chemical industry, but enough has been written to demonstrate the marvelous development which has taken place in the last fifteen or twenty years. What the future holds for the enterprising investigator, no one can foretell.



Carbon bisulphide plant of Edward R. Taylor in process of construction.



Courtesy *Metallurgical and Chemical Engineering.*

Manufacturing oxygen and hydrogen by electrolysis of water.

SOME EXAMPLES OF THE COMMERCIAL APPLICATION OF ELECTRICITY TO CHEMISTRY

The Technically Trained Foreman

Educating Men to Co-operate with Expert Chemists

By Allen Rogers, Ph.D., Pratt Institute

A CHEMIST for one of the large varnish factories near New York city had worked out a formula for what appeared to him to be a very high grade product. He turned the formula over to the varnish maker with the request that he make up a batch in as practicable way. The varnish was made, but when tested failed absolutely to give the anticipated results. On making an investigation it was found that resin had been intentionally substituted for the fossil gum that was designated in the formula.

In a tannery where a pack of skins was being treated by a new process of betting, the foreman turned in steam so as to convert the stock into gelatine, and then claimed that the process had dissolved the skin.

Many other instances of this sort could be cited, showing on the part of foremen a disposition to hamper the work of a chemist. It is safe to say that three out of five foremen to-day will do all in their power to make an experiment go wrong. While even men in higher positions will often disparage the chemist's efforts and take the advice of a so-called practical man. To be sure the chemist is often wrong, but usually for the reason that he has been given no opportunity to become familiar with the actual working conditions. The real reason for the lack of co-operation between chemists and foremen lies in the fact that the average foreman or superintendent, being very jealous of what he knows, is afraid that some one higher up will discredit his ability, while at the same time he may fear that the chemist will get his job. On the other hand, the chemist is often to blame as he approaches the man with an "I know everything" attitude, which from the start antagonizes the one with whom he should be on friendly terms.

It is the object of the present article to show what is being done to improve industrial conditions by giving the foreman a technical training. This has involved a radical departure from the usual method of chemical instruction. The writer humbly begs your indulgence for going into detail when referring to this work which is so close to his heart.

In September, 1906, the Pratt Institute inaugurated a new course, known as Applied Chemistry, at which time the writer was appointed to take charge of the Industrial Chemistry. He was directed to equip his laboratory and arrange his course so as to give the student a training along such lines as would have a practical bearing upon manufacturing operations, and would fit the students to become foremen, superintendents and heads of departments in our numerous chemical industries.

As no other schools were giving such a course it became a matter of originality, to work out the details of which was no small undertaking. To meet the demand of a large number of young men who could not afford the time or money for a four year course with college requirements, the course was made but two years in length, and only such subjects included as had a direct relation to manufacturing operations. To afford the necessary practical instruction, five miniature factories were installed, consisting of Chemical Works, Soap Works, Dye Works, Paint and Color Works and a Tannery.

In opening the year's work one man is assigned foreman of the Chemical Plant and is given four of his associates as assistants. Here the preparation of chemicals is carried out on a fairly large scale, the students become familiar with the handling of steam jacketed kettles, vacuum pans, suction pumps, vacuum filters, filter presses, centrifugal pot driers, and drying ovens. It is not only the idea of showing how certain chemicals are made, but the broader question of operating typical apparatus which is of the most importance. The foreman ship system is of value as it gives the student experience in handling men and assuming responsibility. All orders also are given directly to the foreman who in turn must transmit them to his men and must see that they carry out each operation with accuracy and dispatch. It is part of his duties, likewise, to see that his men are kept busy, that his factory is kept clean, that his machinery is in perfect condition and that all products manufactured should be made at a profit. The student assigned as oiler each week also reports to the foreman for instruction. As one group of men finishes the assignment by the chemical works another takes its place and so the work continues.

Those men of the class not employed in the industrial laboratory are engaged on analytical problems in the technical laboratory where they are required to make a complete analysis of such substances as water, gas, coal, cement, soap, oils, pigments, paints, tanning materials and other commercial products. It is the belief of the writer that the analysis of such materials not only familiarizes the student with common analytical problems, but at the same time gives him experience in quantitative separations which will apply to unknown substances more readily than if he had been given abstract analytical problems to solve, and further as these are some of the common substances encountered in the works laboratory he is prepared from the start to undertake such analyses. It is not the object of this course, however, to turn out analytical chemists and this training simply supplements the more important industrial instruction.

When the first group of students has remained in the technical laboratory for two weeks it is assigned to the industrial laboratory again, but this time to the Soap Factory. In this factory not only are various kinds of soaps prepared, with the corresponding instructions regarding the value of the fats employed and the theory of saponification explained, but the student becomes familiar with the apparatus and machinery used in this industry. In this plant he is given more confidence in himself than in the chemical works, for the product which he makes must be of the highest quality to escape the criticism of his classmates and what is still more important, it must be good enough to sell. During the past year 4,000 pounds of toilet soap were made in this model soap factory, all of which found a ready market. The equipment of the soap factory consists of an eighty gallon lye tank, five hundred pound kettle, one hundred pound crutcher, frames, slabber, cutting machine, chipper, soap mill, plodder and press.

Next in order comes the Paint and Color Works, the equipment for which consists of color tanks, filter press, ball mill, kneading machine, change-can mixer, iron mill, two water-cooled 20 inch buhr stone mills and liquid mixer. During the past year over 400 gallons of ready mixed paints were made by the students at work in this factory all of which was sold and gave entire satisfaction. Besides the regular work a large number of white paints were made for the American Society for Testing Materials which will be tested out on fences erected in Washington for the purpose.

In the model Tannery the group is next assigned. Various processes of vegetable and mineral tannages are carried out together with all of the operation involved from the raw material to the finished product. The equipment for this factory consists of a leach house, soak pits, lime pits, suspender pits, liver pits, paddles, mills, fleshing machine, shaving machine, unhairing, splitting, setting out table,

(Continued on page 29)



Where paints are mixed and tested.



A corner of the tannery.

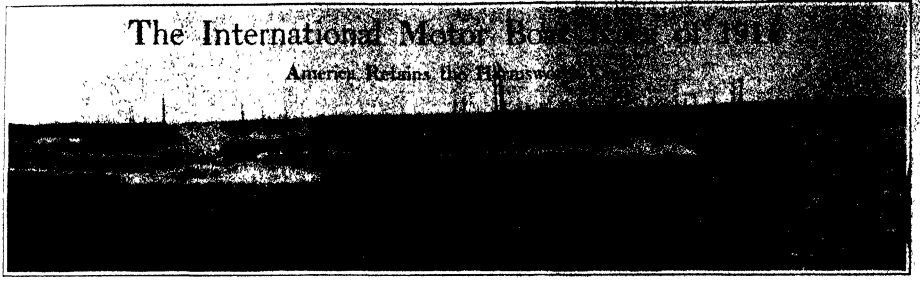


A part of the chemical plant.

MINIATURE FACTORIES WHERE FOREMANSHIP IS TAUGHT

The International Motor Boat [illegible] of 1911

America Retains the Harmsworth [illegible]



WHEN last year, the fleet hydroplane "Pioneer" of the Duke of Westminster all but won the Harmsworth Cup and showed a speed of forty miles an hour, American motor boat enthusiasts awakened to the development of the hydroplane. It was apparent that a displacement boat like the "Dixie III" would not stand a chance against a hydroplane, provided the latter had no mishap. As a consequence, a syndicate composed of H. H. Melville and Frederick K. Burnham, the Commodore and Vice-Commodore of the Motor Boat Club of America, and Mr. August Heckscher, a member, commissioned Clinton H. Crane to design a hydroplane capable of defending the cup. Mr. Crane, the designer of the other "Dixies," designed a single-step hydroplane, and equipped his craft with two 250 horse-power 8-cylinder V-type Crane motors driving twin screws. This new boat, the "Dixie IV.," is said to have made a speed of 45 knots for several miles. Our photograph shows her at her highest possible speed during a private trial before the race.

In order to win the trophy this year, it was decided that the vanquishing boat must lead in two out of three races. The first of these races was run on Labor Day, September 4th, under perfect weather conditions. The British team consisted of the "Maple-Leaf III.," a speedy English hydroplane fitted with two 12-cylinder motors of 375 horse-power each, which is claimed to have made 49⅝ knots over a mile course on the Solent, the "Pioneer," another hydroplane designed by an American, Mr. Wm. H. Fauber, and fitted with a 12-cylinder Wolseley-Siddeley engine of 380 horse-power, and the "Tyreless III.," a displacement boat fitted with two Brooke engines of 120-horse-power each set in tandem.

The American team, headed by the "Dixie IV.," also contained the "Disturber II." and the "Viva," both of which were chosen at the eleventh hour. The latter is a displacement boat fitted with four 8-cylinder 100-horse power Emerson two-cycle motors arranged in pairs in tandem, while the "Disturber I." is a Fauber hydroplane, owned by James E. Pugh, of the Chicago Yacht Club. She is 31 feet 10 inches in length and is equipped with two 8-cylinder Stirling motors of 140 horse-power each.

As usual, the 1911 race was held in Huntington Bay over a triangular course of 7½ nautical miles. Four rounds of this course were required, making a total of 30 nautical miles. The start of the race is shown in the photograph which heads this article. The "Dixie IV." led from the start, but was closely pursued by the "Pioneer." The powerful "Maple-Leaf III." broke her steering gear near the end of the second round, and was towed to her anchorage. The "Tyreless III." also gave out after covering 18 nautical miles, and she, too, was towed in. As neither of these boats was disabled so that they could not proceed under their own power, they were both disqualified, and in the second race the "Dixie" had only the "Pioneer" to vanquish. Throughout the first race on Labor Day, the "Dixie" maintained her lead, and finally crossed the line 59 seconds before the English boat, and more than half a mile in advance. The time of the "Dixie" was 51¼ minutes, and that of the "Pioneer" 52 minutes 14 seconds. The "Disturber" finished in 52 42, and the "Viva" in 1 04 12. The average speed of the winner was 35 12 knots or 40 58 statute miles an hour. The "Pioneer" averaged 34 42 knots, or 39.62 miles an hour. As the "Dixie IV." made 39 86 knots, or 45 83 miles an hour, in the elimination race five days previous, it is apparent that she is much the faster boat. It was not found necessary to let her out in the first race, and even less so in the second. The "Disturber II." averaged 32 31 knots and the "Viva" 27 97.

In the second race on September 5th, the "Pioneer" was slightly ahead of the "Dixie" at the start, but the latter overhauled and passed her on the second leg of the course and at the end of the first round was four seconds in the lead. A heavy wooden packing box in the wake of the "Pioneer" was hit by the "Disturber II." damaging her severely. Her owner beached her before she filled sufficiently to sink. Soon after the start of the second round the British boat was obliged to stop owing to engine trouble, and during the 19 minutes she was at rest the "Dixie" lapped her and continued steadily to the finish. The "Pioneer" got under way again and was apparently good for second place, but again the unexpected happened. Her propeller shaft broke while on the last leg of the final round, and within sight of the finish. Consequently the laurels went to the "Dixie," which was a minute and 32 seconds longer in covering the 30 nautical miles than on the previous day, averaging 33 40 knots, and to the "Viva," which averaged 23 06, or 27.5 statute miles an hour.

For the first time, in the race this year, America made an excellent showing both as to speed and reliability. All three of our boats finished the first race, and but one dropped out of the second, owing to an unfortunate accident and to no fault of the machinery or hull.

While the Duke of Westminster did not see fit to increase the power plant of the "Pioneer," and even was willing to wager $100,000 that she would win, the men who built the cup defender doubled her power plant and installed two 8-cylinder V-type four-cycle motors of 250 horse-power each. The motors have a bore and stroke of 7¼ inches, and make a maximum speed of 950 revolutions per minute, although, in the race, they ran at only about 800 revolutions per minute. The "Dixie IV." has twin screws, one propeller shaft being directly coupled to the forward motor, while the other is driven by spur gears from the rearmost motor. This was made necessary on account of the steep inclination of the boat and propeller shaft when under way. A novel feature of the "Dixie IV." is the attaching of a metal step beneath the hull directly under the forward engine. This arrangement makes it possible to build as staunch a hull as is obtained with any displacement boat, and the action of the single step is certainly very satisfactory. The "Pioneer," it will be remembered, has multiple steps according to the Fauber patent. In all there are five of these steps constructed in the bottom of her hull.

The fact that none of the American boats gave out on account of engine trouble speaks well for American motors, which have heretofore not shown up to good advantage in international or other races. The "Viva" was equipped with Emerson standard 8-cylinder, two-cycle motors, and she ran very regularly in both races. This is the first time that a two-cycle motor has been used in an international motor boat race. Despite the fact that the "Viva" is a hydroplane equipped with four 100 horse-power, extremely light weight, two-cycle motors, she did not at any time develop a speed of much more than 30 miles an hour, although her regularity was very good. The "Disturber II." was equipped with two standard four-cycle motors of the 8-cylinder V-type, and this boat also demonstrated the reliability of the engines besides showing fairly good speed. True to her name, she disturbed the water to a great extent, and made much more fuss than any of the other craft.

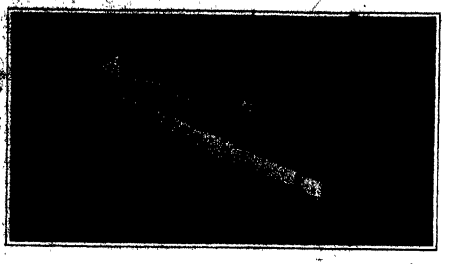
Now that America has won the Harmsworth trophy for the third time in succession, it is to be hoped that our motor boat enthusiasts will keep it here permanently by building other higher-powered and more advanced types of boats for the future annual races.



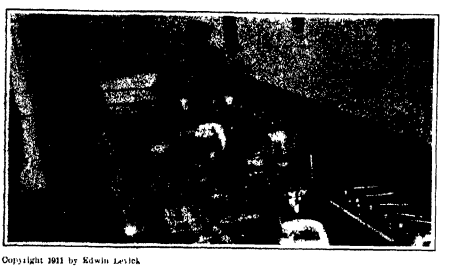
Copyright 1911 by Edwin Levick

The "Dixie IV." making a tremendous burst of speed and skimming the surface at nearly fifty miles an hour.

THE WINNING BOATS AND ENGINES IN THE HARMSWORTH CUP RACE



The "Viva," a Fauber hydroplane equipped with four 100-horse-power motors.



Copyright 1911 by Edwin Levick

The four 6-cylinder Emerson 2-cycle motors installed in the "Viva."

Halos and Rainbows

THE correspondence columns of the scientific journals are overburdened with letters from persons who have witnessed one or another of the optical phenomena of the atmosphere, and who describe the same in such a way as to give the impression that they have never opened a book on optics. Strange to say these letters frequently come from men who are more or less prominent in the scientific world. One can hardly escape the conviction that a large number—perhaps the majority—of physicists, meteorologists and astronomers have profited little by the researches of Monge, Biot, Bravais, Mascart, Pernter and other students of atmospheric optics.

There is, for example, a particularly beautiful form of halo—the "circumzenithal arc"—which is nearly always described by persons who thus report their experience as if the phenomenon in question was one of which they had never heard, and which they are consequently unable to call by its correct name or bring into relation with other luminous meteors. A description of this kind appeared in *Nature* for May 11th, 1911 (p. 349). The writer, who obviously had not the slightest acquaintance with the terminology of optics, referred to what he had seen as a "rainbow." Strange to say, the editor naively concurred in this ignorant diagnosis, and published the letter under the heading "A Zenith Rainbow;" notwithstanding the fact that, in a note appended to the letter by a well known meteorologist the correct name was applied to the phenomenon.

Several forms of halo are decidedly common, though they often escape the attention of the casual observer. At the Observatory of Montsouris, near Paris, where halos are systematically watched for, the circumzenithal arc was seen on 111 days in ten years, an average of one day in 33.

The Saharan traveler who has occasion to mention a camel does not call it "a large brown quadruped with a hump on its back." He saves times and obviates misunderstandings by saying "camel." On the other hand persons constantly report that they have seen in the sky a luminous appearance of such and such an size and shape along with other particulars that may or may not possess real scientific interest, the gist of which is merely that they have witnessed the tangent-arc of a halo, a sun-pillar, a lunar cross, a parhelion, or some other luminous meteor that ought to be, but is not, perfectly well known to the majority of educated people.

The SCIENTIFIC AMERICAN believes that its readers will welcome the appearance in its columns, in the near future, of a series of illustrated and plainly worded articles on the optical phenomena of the atmosphere.

The "Mouth-organ" Industry

TROSSINGEN, in the Black Forest of Germany, is the center of the foreign harmonica industry, where most of the world's "mouth-organs" of the cheaper grade are made. One factory alone is said to employ several thousand hands, and the number of harmonicas turned out by all the factories there is enormous, amounting to almost a million annually.

Although the United States imports a large number of the cheap German "mouth-organs," the finer grades are made in this country, and these are held to be equal in every way to the more expensive instruments made abroad. The Germans devote some attention to the manufacture of the more costly "mouth-organs," but their principal output is the cheaper grade.

Among the finer grades of harmonicas are the kind known as "concert," which come in sets of from four to a dozen and sell for several dollars apiece. These are tuned in various keys. In one form they show six harmonicas of different keys grouped about a central stem. Many of the elaborate and expensive harmonicas are handsomely decorated with designs of gold and silver upon mahogany. The wood used in the cheaper grades is pine.

Portable Swimming Tanks

A LARGE and permanent swimming tank is a costly affair, especially if it is located in the center of a large city, where ground is valuable. Many German cities are provided with such establishments but many others have been deterred from following the example by the great cost involved, which may be estimated at about $100,000. The swimming bath in Munich cost more than twice this sum. Attempts to provide cheap substitutes for these expensive establishments have hitherto been fruitless. The first practical solution of the problem is exhibited at the International Hygiene Exposition in Dresden this summer and is described in *Hygiene*, the bulletin of the Exposition. This first portable swimming tank was designed by H. Recknagel, a well known engineer of Berlin, and was opened on the 14th of May. The basin for an establishment of this kind can be constructed cheaply of concrete on any plot that is likely to remain vacant for a number of years in a central and accessible part of the city. The cost of a cheap basin of this kind will be covered by the revenues in a comparatively short time, and when the land is required for building, the basin can be rebuilt on another vacant plot. The water can be obtained from a river, lake or spring, or even from the city mains, as the quantity of water required will not be very great if the English filtration system is employed. By continuous purification of the water in this way the number of bacteria per cubic centimeter in the bath can be reduced according to the latest investigations, below the number found in the freshly entering water. A light shed with a canvas roof which will protect the bathers both from the heat of the sun and from cold winds can be cheaply erected over the basin. These movable swimming baths are equipped with locomobiles which will be found useful for various purposes, including the heating of the water and the air in cool weather, thus prolonging the bathing season the operation of the pumps and filters, etc. The locomobile can also be employed for the production of waves by means of the simple Hoeglauer system by which it is possible to produce powerful waves three feet in height. This wave motion not only increases the pleasure of the bath, but presents a sanitary advantage as according to Dr. Brieger, it effects a mechanical destruction of bacteria, it also affords an opportunity for practice in swimming in rough water which is a valuable acquirement.

Such a swimming tank, measuring 10 by 130 feet with its shed, etc., can be constructed for about $20,000.

Everyday Misnomers

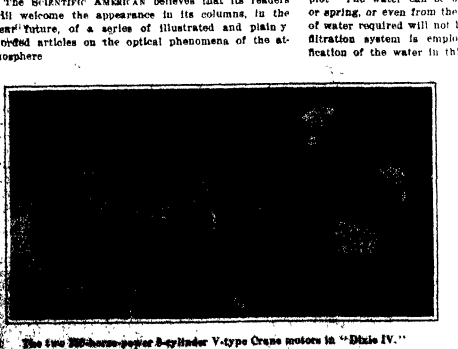
A VAST number of incorrect notions are acquired by reason of misleading names. For instance, we ask for a Dutch clock. We get the kind we want, so it really doesn't matter that it is not a Dutch clock at all, but one of German manufacture. Practically all the wooden clocks called Dutch are made in the village of Freyburg in the Black Forest. This misnomer is due to simple mispronunciation—"Deutsch" meaning, of course, German.

Nothing is more natural than to assume that India ink comes from India, but it does not, and never did, any more than does India rubber. India ink is a Chinese product, and India rubber comes from South America.

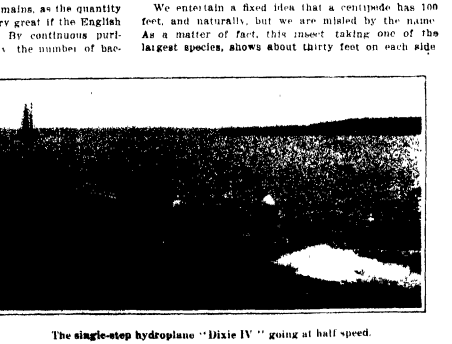
Camel's hair brushes are not made from the hair of camels, but from the hair of the tails of Russian and Siberian squirrels. Camel's hair is, however, employed in the manufacture of certain fabrics to be made into shawls, etc., and it is sometimes mixed with silk.

French briar pipes are not made from the roots of briar, but from the root of a white heath which attains a considerable size in the south of France, where it is sedulously cultivated for pipemaking purposes. The name is derived from the French bruyère the dialect form of which is brière, meaning heath.

We entertain a fixed idea that a centipede has 100 feet, and naturally, but we are misled by the name. As a matter of fact, this insect taking one of the largest species, shows about thirty feet on each side.



The two 300-horse-power 8-cylinder V-type Crane motors in "Dixie IV."



The single-step hydroplane "Dixie IV" going at half speed.

THE WINNING BOATS AND ENGINES IN THE HARMSWORTH CUP RACE

Curiosities of Science and Invention

Seventy Automobiles Crossing the English Channel

With recent Prince Henry Race placed navigation before an interesting task, viz: loading on a passenger steamer with in a few hours no less than 70 automobiles and taking these cars with their drivers, their owners and their families, across the Channel to Southampton, where the race was to be continued through England and Scotland.

Most elaborate plans were required to carry out this transport. The number and kinds of cars to be stowed in the various holds of the ship had to be accurately ascertained beforehand so as to avoid any hitch. As the small hatches generally used on passenger steamers were likely to afford difficulty in transferring the automobiles special loading means had to be devised for loading the cars. A platform was built with two iron brackets bent upward at one end. This was suspended from the crane so that it could be adjusted to any inclination thereby reducing the horizontal component sufficiently to provide admission to the hatch. The front wheels of the cars rested against a beam on which sand bags had been arranged for protecting the tires. Adjustable guides at each side protected the cars against any lateral motion. The loading of the cars was effected without any hitch or damage in about six hours, which is the more remarkable as the irregular arrival of the cars resulted in loss of time. The unloading at Southampton also took six hours.

No further difficulty was experienced in stowing the cars in the holds and decks, those located on wooden decks were propped by pieces of timber nailed to the deck, and those standing on iron decks by sand bags slipped in front of the wheels.

The unloading at Southampton was likewise performed without any hitch and with the exclusive use of the ship's own hoisting devices within six hours. Immediately after the landing of the cars, their gasoline tanks were filled. The cars were then submitted to a thorough cleaning and the race was continued on English soil.



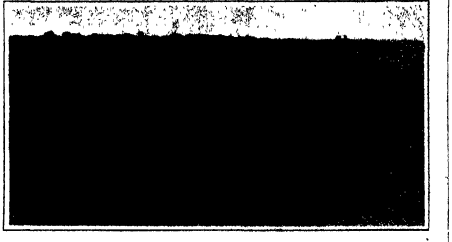
Shipping seventy automobiles.



Tipping a car to enter a hatch.

A Stranded School of Whales

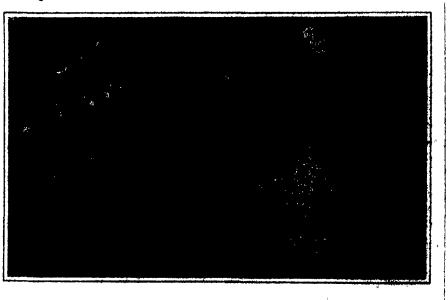
On an island off the northwest coast of Tasmania near the entrance to Duck River thirty-seven sperm whales were stranded early this year. How they came to be driven ashore is not known. We can imagine them panic-stricken and stampeding like a herd of bison, but more probably they were driven by hunger and followed a small shoal of fishes, pursuing them into dangerously shallow water at high tide, where they were stranded when the water receded. Whatever the cause, the whales were driven far up on the sands, and being unable to work their way back into water, soon perished. They were discovered by the captain of a ketch who knew that there were whales about by the oiliness of the water and the stench. The stranding of so large a school of whales is decidedly unusual and many excursions to the island have been made by sight seers as well as hunters of whalebone, ambergris and spermaceti. Even the novice will recognize these whales with their enormous blunt heads and narrow toothed jaws as belonging to the sperm or cachalot species.



Thirty-seven whales stranded off Tasmania.

Flower-picking Apparatus

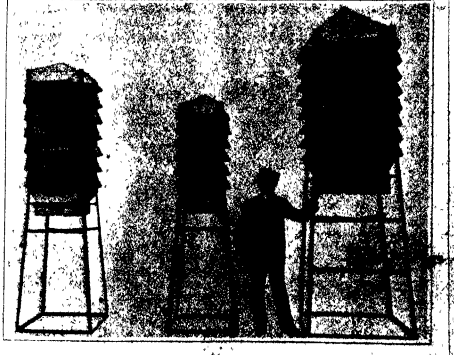
The accompanying illustration shows an apparatus for plucking flowers and collecting seed, which is intended to save a good deal of labor in the garden. The apparatus consists of a tube connected with a pair of shears. At the forward end of the tube is a fork, which is slipped under the flowers. The blossoms imprisoned between the prongs are severed by a blade traveling down the fork and are dropped through the tube into a receptacle at the rear of the apparatus. The device will cut off single flowers very quickly, but also can be used in large. When the flowers are plucked by hand it is almost impossible to break a twig without leaving behind a long sliver of bark. Sometimes even a whole plant must be torn up by the roots. The apparatus can also be employed for collecting seed capsules which are often crushed when picked by hand so that the seed is lost. The entire capsule drops uninjured into the receptacle at the rear, so that the seed is preserved.



An apparatus for picking flowers and seed.

Fighting Moths in Egypt

In order to increase their collections of insects, two entomologists, Messrs. Andres and Maire, of Alexandria, Egypt, tried to improve upon the fermenting liquids commonly used for the purpose of attracting insects. Their experiments proved exceedingly successful, and in 1905 they used them to catch the injurious moths that infest the cotton fields. For their first trials, they employed bands of jute cloth, four inches wide and about sixteen feet long, soaked in the mixture, and hung on posts where the wind would carry the scent over the cotton fields. Moths were attracted by the hundreds, and, by means of chloriform, they were stupefied, so that they dropped into vessels of water. As this method of procedure was not commercially practical, the inventors devised traps in which the insects could be caught. A set of these traps is shown in the accompanying engraving. They are made of bands of galvanized wire gauze placed in a slanting position, with a very narrow opening between the bands to admit the moths. Within these traps the cloth strips are hung. The moths feed on the liquor soaked in the cloth strips, and drop into vessels of kerosene, at the bottom. As many as five thousand moths have been caught in one of these traps in a single night. The success of these experiments has resulted in the use of a great many moth traps, and the catches are counted by thousands, greatly reducing the hand-picking labor. When the traps are used all over the country, it is expected that the pest will disappear from Egypt. The same type of trap is now being tried in France by the wine-growers, who are fighting the moth known as *Cochylis*.



Traps for the moths that infest Egyptian cotton fields.

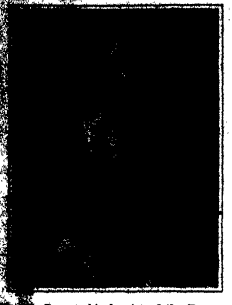
When the Smoke Nuisance is Punishable

"The man who built his factory some years ago, when architects were in the habit of forgetting to provide the necessary space, and engineers were therefore unable to install boilers adequate for the work to be done, is entitled to some sympathy when he falls into the clutches of the present-day smoke abatement laws—though even in these cases the nuisance can usually be abated at little cost. But the man who to-day, with all its improved knowledge and appliances and practices in sight, erects and operates a smoke-producing heating or power plant should be promptly stopped and punished as the creator of a public nuisance as unnecessary as it is disagreeable and injurious."—*Dr. Holmes.*

Aeroplanes in War.—For the first time in Germany aeroplanes will participate in the army maneuvers to be held near Metz, beginning the 25th inst. Heretofore only dirigibles have participated in the German maneuvers, but the results with these were so poor last year that the Emperor has decided to try aeroplanes.

The Inventor's Department

Simple Patent Law; Patent Office News: Inventions New and Interesting



Dr. J. Dorset, biochemist of the Bureau of Animal Industry. He discovered an absolute cure for hog cholera.



Brig.-Gen. A. R. Buffington. Joint inventor of the mounting for our twelve-inch disappearing guns.



Brig.-Gen. W. Crozier, joint inventor of the mounting for our twelve-inch disappearing guns.



Dr. J. W. T Duvel, who discovered a standard method for determining the moisture in grain

Inventing for the Public

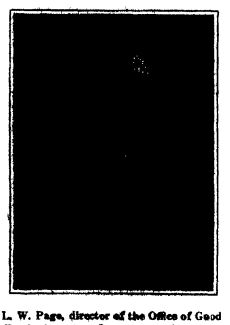
Government Inventors Who Have Given Their Patents Away

By William Atherton Du Puy

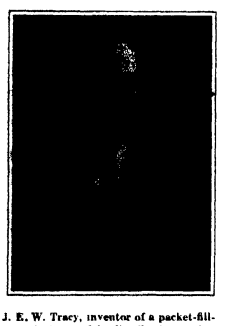
THERE is an unwritten law in the government service which stipulates that he who, while drawing a salary from Uncle Sam, makes an invention, shall demand no royalties upon it but shall dedicate it freely to the public. This unwritten law has not always controlled. It was much more often disregarded in the past than in the present. In the history of the government service there are a number of instances of men connected with it who have made inventions from which they have made great fortunes. These instances are, however, growing more infrequent all the time. They were always greatly in the minority. Of the 23 patents that have been issued by the Patent Office to government employees, not a copper cent have been kept from the public. The idea of profiting by his own invention has practically been given over by the government employee and the exercise of his inventive genius is now almost entirely patriotic.

But this need not be true under the law. There is no law which stipulates that the government employee may not profit by his inventions, whether made on government time or in private. Should the government employee inventor see fit to demand the right to his invention there is no law which refuses him whatever profit he may derive from it. Court decisions in general practice take the view that when an employee takes out a patent the subject matter of which is in general line of his employment, there is an implied license of the employer to use the patent. Upon this basis a feeling grew that the government had a right to use the patents of its employees. This idea went still further, upon the theory that the public was the employer, and the practice grew up of giving these inventions freely to the public. The Secretary of Agriculture has gone so far as to issue a general order in which he requires employees making useful inventions to dedicate them to the public.

This view of the matter has been generally accepted in the government service. There are many inventions that might have made their originators wealthy that have been surrendered. There are many others that are merely useful and economical to the government, saving it thousands of dollars a year, which it accepts from employees and for which it recompenses them in no way. The Bureau of Corporations was some time ago asked by Congress for an opinion on the status of the inventor in the government service and the government's claim upon his invention. That report stated that the present attitude of the government tended to discourage invention and held that government service would be improved if inventors were allowed to profit by their patents, being thus encouraged to make inventions along the lines of their work.



L. W. Page, director of the Office of Good Roads, inventor of a waterproof cement.



J. E. W. Tracy, inventor of a packet-filling device used in distributing seeds.

But this is not the present practice. When a man in the government service to-day makes an invention he dedicates the free use of it to the government and to the people of the United States. He has one chance of making money out of it and that is through a sale of foreign rights. Neither practice nor public opinion denies him this. It would seem that there would be little reason why a government employee inventor should take out a patent, if he is not to profit by it after all, but his case is peculiar, as he is usually a scientist, devoting his life to a given line of work and to the service of the public. His invention has something to do with his work and with its effect on the public. He is anxious that the public should profit by his work. If his invention is of any value and he fails to patent it, there is the chance at any time that somebody else may take out the patent and collect royalties from the public. The actual effect of his taking out the patents and giving them to the government and to the public is to prevent some more mercenary individual from collecting royalties. These patents are for the protection of the public rather than for the protection of the patentee.

Among the newest of the patents that appear to be of great importance to the people is that of waterproof cement, for which letters patent have been issued to Logan W. Page, director of the Office of Good Roads, Department of Agriculture. This cement is made by mixing oil with the ordinary cements. The principle also applies to mortars and concretes. It produces a cement that, in the first place, will hold water and may be used for such structures as water tanks. Concretes that are otherwise easily penetrated by water become waterproof. A lining of waterproof cement or concrete will make an otherwise porous structure water tight.

Last May streets were constructed of oil mixed concrete, one in New York city, one in Washington and two bridge surfaces in Ridgewood, N. J. A few months ago a vault 105 feet long by 18 feet wide was constructed of this material in the Treasury Department. The top was a flat reinforced concrete arch and as sufficient tests in bond had not been made ordinary concrete was used to surround the reinforcement. After it had set three inches of a ten per cent oil mixture was placed above. The vault has been perfectly waterproof under very trying conditions. A large water tank so treated in the good road laboratory with a ten per cent oil mixture is absolutely waterproof. Extensive experiments made with oil concrete in basement floors have given excellent results up to the present time. No moisture enters the walls of houses built of this waterproof. Water poured on a basement floor made of it will roll up in globules instead of entering the cement. Col. Goethals is experimenting with it as a material for building locks. It promises to find extensive use in the building trades.

Mr. Page patented his product and two methods of making it. The demand for the material already indicates that there would have been millions in the patents if privately handled.

Dr. Marion Dorset, biochemist of the Bureau of Animal Industry, is a young scientist of great inventive genius. He it was who first found the germ that is responsible for cholera in hogs. This germ is so small that the most powerful microscopes cannot detect it nor can the most delicate filters remove it from water. Dr. Dorset, having isolated the bacterium invented a serum with which to combat it. The serum and the processes of manufacturing it were protected by patents.

Hog cholera was causing a loss of $15,000,000 a year in the United States. When the disease broke out in any locality it went on and on with no power to oppose it. But the serum which Dr. Dorset patented is an absolute antidote. He has repeatedly proven its effect. He has time after time taken a given number of pigs, inoculated half the number and put

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MANUFACTURING OPPORTUNITY.—The Waltham Building Association is in a position to erect a modern manufacturing building on line of B. & M. Railroad with proper financial backing who is desirous of locating in a growing city. Apply to Waltham Building Assn. Hollis E. Denton, Treasurer, Waltham, Mass.

GOOD BUSINESS OPPORTUNITY.—Owner of well established business, manufacturing and selling a specialty readily sold into general and home trade, desires to interest business man who can be expanded individually. No special manufacturing experience necessary, since present trained assistant help can be retained. This is an exceptional opportunity for any young man, who can command $10,000. Address "Pennsylvania," Box 775, New York.

FOR SALE OR ON ROYALTY.—Street car ticket holder. Strong, simple and thoroughly effective. Cost less than a cent each. For further particulars address Stokstad, Harper Wash.

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THE DEAF HEAR INSTANTLY with the Acousticon. For personal use, or to interest others. Booklet describes. You only hear before you purchase. Booklet free. (Imperial Acoustic Co. 202 Beaubien St., Jamaica, N.Y. City. Paris branch 6 Rue d Hanovre.

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ARTIFICIAL RAIN.—New system of irrigation combined with electrified water. Best and cheapest fertilizer. Patented. Unlike anything else. Will work on any quality basis. 2 Olsson, 32 W 9th St., N Y City.

FOR SALE. Patent for a perfect toy balloon. Something new. Very interesting. Will sell entire or part interest or adults. For further information address Balloon, Box 775, New York.

UNITED STATES PATENT FOR SALE. No 1091 071. Automatic Mail Order Carrier. For further information address John Gronick, 1531 Buttner Street, Philadelphia, Pa.

FOR SALE.

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CALIFORNIA LAND, planted and operated by experts is a splendid investment. Black has best of all crops. Write Geraldinton Farms, Newcastle, California. (Packers Geraldinton Place).

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LOCAL REPRESENTATIVE WANTED.—Splendid income assured right man to look after our repeat business after learning our business thoroughly by mail. Former experience unnecessary. All we require is honesty, ability, ambition and willingness to work. Pleasant business. No soliciting or canvassing. This is an exceptional opportunity for a man with limited capital to enter a paying business without capital and become independent for life. Write for particulars. Full explanation sent free by H. Marion Price, The National Co-operative Realty Company, L 703 Marden Building, Washington, D. C.

MISCELLANEOUS.

"I AM THE SCIENTIST OF MY MISTAKES."—Astounding theories. Solid opposite Kepler's theory of vortex motion. Matter does not build together as Part 2 read, but of universal opposites, as set forth in fact. No "periodic" energy. Only one ultimate element, another. Momentum underlies all matter, basis of all energies, and phenomena, not time, from energy measure. An Amazing Calculation. Part 3 of Mistakes. Universe call based upon sets of basic orbital vortex motion of all her cents earth and heavens. Astounding theory. Pamphlet, ten cents (coin). C. C. Bates, Pascola, Ill.

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MOTORCYCLES CHEAP.—Send to-day for free catalog of new and used motorcycles. Also motorcycle accessories and attachable motor outfits for converting bicycles into motorcycles. Shaw Manufacturing Company, Dept. 24 Galesburg, Kans.

them all in a pen with infected pigs. All of those not inoculated always die and not one that has been treated is affected. It is one of the most absolute antitoxins known to science.

When hog cholera now breaks out in a given locality, all the animals thereabout are inoculated. The outbreak soon wears out for lack of material upon which to feed. An application of the cure with a moderate degree of efficiency results in the saving to the nation of $15,000,000 a year, and this amount would reach considerable proportions in even the span of one man's life.

Dr. Dorset is also the inventor of a secret ink used by the government in stamping meats which have been passed upon by the government inspectors at the packing houses. There was formerly in use in marking these meats a tag that was patented by a private firm. These tags were costing the government about $60,000 a year and were not nearly as effective as the ink which puts the stamp into the meat itself. Dr. Dorset's ink is not patented. The secret of its manufacture can be more effectually kept through not patenting it. The method of applying it to the meat and the devices used in the process, however, are covered by a government patent and in this way the process is doubly protected.

Despite the invention of a hog cholera serum, which saves the people $15,000,000 a year, and the ink which saves the department $60,000 a year direct, this young scientist receives but $3,500 as an annual stipend. He is the sort of man, however, who is more interested in his work than in money, and is entirely satisfied.

J. W. T. Duvel is the government's specialist on grain standardization. It was in connection with this work that he found there was a variation in the weight of grain from five per cent to twenty-five per cent, due to the amount of moisture it contained. Obviously this moisture content should be reckoned in selling grain. Dr. Duvel invented a moisture tester that is now in use in most of the elevators of the nation but from which he has never received a cent in royalties.

The scheme for ascertaining the amount of moisture a given sample of grain may contain is based upon the possibility, under certain conditions, of boiling it off and then condensing it. A given sample of grain is carefully weighed. Then it is placed in oil that has a boiling point a great deal higher than that of water. It is heated to a temperature where the water in the grain goes off in vapor. This vapor is recondensed and carefully weighed. Its weight in proportion to the grain from which it came is the percentage of moisture in the given grain. With Dr. Duvel's device the test may be made in a very few minutes. The same principle, under another patent, is applied to a test of the amount of water in butter.

Joseph L. Harley, an employee of the Bureau of Engraving and Printing, is the patentee of a so-called "press register." This device, when attached to a press, records every impression that is made from it. In the Bureau of Engraving and Printing there are five hundred presses that are used in printing the money, and the postage and internal revenue stamps of the government. This registering of the number of impressions that are made from a given press serves as a check and precludes any possibility of printing money or stamps that are not accounted for. It has been in use by the government for many years and Mr. Harley has never received any compensation for it.

C. R. McBlair, an employee of the Supervising Architect's office, is the patentee of a photographic process which is used in duplicating designs made in that office. The Supervising Architect and Mr. McBlair have both signed a statement to the effect that from $5,000 to $8,000 a year is saved the government through the use of this invention. Yet no royalties are paid to the inventor.

Brig. Gen. William Crozier and Brig. Gen. A. R. Buffington, U. S. A., are the patentees of a mounting for the great twelve-inch disappearing guns, commonly in use in the army. So heavy and so complicated are these devices that it costs $45,000 to manufacture one of them. The records of the Chief of Ordnance, however, show that 395 such gun carriages, embodying features covered by this patent, have been used by the government. No royalties, however, have been paid for this use. The letters patent taken out by these army men state that, "We hereby dedicate to the government of the United States the free right to use, to make, and to have made in the United States for its own use, gun mountings embodying this invention." This procedure is somewhat unusual in the army and navy for, in those services there has been a much stronger tendency on the part of inventors to insist upon profiting through their patents.

B. L. Andrus, superintendent of the mail look repair shop of the Post Office Department, is the inventor of a conical pointed grommet which is used extensively in all the registered mail work and in ordinary mail sacks and pouches of the government. Officials of the Post Office Department admit that this invention would have been a bargain had the government bought it outright for $10,000. There are, in the Postal Service, a great many of these smaller inventions which are not applicable to any other use but which are of great value to that service. Many of these have been patented for the protection of the government against the same action on the part of outsiders. The inventors have, however, received no profit from them.

J. E. W. Tracy, of the Bureau of Plant Industry, is the patentee of a device for the automatic filling of all those seed packets which members of Congress frank to constituents throughout the country. The use of this machine makes it possible for the government to secure competitive bids for putting up seeds. The inventors and owners of other practicable machines state that it is worth $1.32 a thousand packets to do this work. This machine enables the government to save at least three cents per thousand on its packets. As approximately 37,000,000 packets are filled annually, the Tracy patent secured a saving of about $37,000 a year to the government. The inventor, however, in no way profits through this saving.

Probably the most complicated machine that has ever been invented by a government employee is one in use at the Coast and Geodetic Survey, and upon which may be automatically figured the time and degree of maximum and minimum tides at any time or place. A very important phase of the work of the Coast and Geodetic Survey is the forecasting of tides and the making of charts recording those forecasts. The computation of the time of high tide or low ebb for a given place is a very complicated process and there are nineteen different elements entering into the calculation. This tide predicting machine takes all those elements into consideration and, with a single operator, automatically gives the answer. To produce the same result with the same degree of accuracy without the use of the machine would require thirty computers, working throughout the year. On a salary basis of $1,000 each, there would be expended each year in hiring these computers, a total of $30,000. William Farrel was an employee of the Coast and Geodetic Survey when, thirty years ago, he devised this complicated machine. He freely gave his invention to the government and never in any way profited from it. Upon this machine the tide forecasts have been calculated since 1883.

Such are a few examples of the hundreds of patents that have been issued to people in the government service and for which they have received no remuneration. That the law does not require their surrender to the government and that they have been none the less voluntarily given over, speaks volumes for the patriotism of the men who are spending their lives in the service of Uncle Sam on a fixed salary.

Notes for Inventors

Harvester Patents.—In a [illegible] rebuttal of the Report, made by the [illegible] A. O. Stanley, Chairman, [illegible] of the House Committee on [illegible] tion of the United States Steel Corporation, Mr. Edgar A. Bancroft, general counsel of the International Harvester Company, conveys some interesting information on the [illegible] ents. "The knotting device [illegible] by Appleby in 1879," according to Mr. Bancroft, "and there has been no material change in the knotting device or in the general type of the self-binder since then. Inasmuch as there are no patents on the essential parts of the self-binder in existence, a fifty million dollar corporation has this year put out 500 binders. The Minnesota State Prison has sold 600 binders and a well-known thresher company has made an experimental binder. . . . The charge that the company furnishes no insentive to improvements in the machines is equally erroneous. On the contrary, it maintains a large and effective staff of inventors, experimenters and inspectors—far larger than ever existed before—at an annual cost of over $[illegible], and it has added many improvements to the machines, and has greatly increased their efficiency and durability."

A Sailor's Invention.—Luke McNamee, of the United States Navy, has secured a patent, No. 1,000,834, for a shock absorber for searchlights. The door of the searchlight is cushioned by means of springs which hold the door out of contact with the body of the searchlight in such manner as to permit the pressure on each side of the door to be equalized and absorb the shocks incident to gun fire.

Another Dedicated Patent.—Logan Waller Page, of the division of good roads of the United States Agricultural Department, has secured and dedicated to the public a patent, No. 1,000,545, for a cement concrete and method of mixing and preparing the same. The method consists in adding to an ordinary cement and water mixture, a quantity of [illegible] volatile mineral oil. The oil is added before the cement begins to set and the quantity of oil used does not exceed twenty-five per cent of the cement.

A New Biscuit.—A biscuit, having an inner mass of starchy and brittle filaments surrounded by a tougher covering of glutinous filaments which have a binding connection in which the ends of the inner filaments are secured, has been patented, No. 1,000,377, to Edward W. Anderson of Washington, D. C.

Death of William D. Sargent.—William D. Sargent, who is said to have associated with Alexander Graham Bell in the telephone matter, died on August 26th, at his summer home in Somerset. The after an illness of several weeks following an automobile trip from his home in Brooklyn. Mr. Sargent was one of the old time telegraphers and a member of the United States Military Telegraph Corps Society and was also well known in the financial circles of New York and Brooklyn.

Destruction of Rats.—An East Africa publication contains a description of a method of destroying rats, followed in Java, in which carbon bisulphide is employed. In carrying out the method a small quantity, usually about half a teaspoonful of the carbon bisulphide is poured into the rat hole and after waiting a few moments to let the liquid evaporate, the mixture of air and vapor is lighted, a small explosion resulting and filling the hole with poisonous gas, killing the rats instantly. Such a process practised openly might be objectionable under some circumstances because of danger from fire resulting from the explosion and a field for invention appears to offer itself to provide some form of fire-proof gun or explosion chamber suitably formed to be inserted in the mouth of the rat hole and adapted to enclose the explosion and discharge the resulting noxious gas into the hole.

The Safe and Sane Way To Keep Blue Prints and Drawings

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"The Search Party"

hunts everywhere. You have a customer, or prospect waiting, or perhaps your Chief has asked for the print. Anyway, important affairs hinge on the finding of it

You may go through the whole pile, lose time, temper, and maybe your Chief's respect for your managing ability, or a possible customer

After sweating blood for 20 minutes you may find it And probably it is badly torn, dusty and frazzled Even if it is in good condition, *you couldn't find it when you wanted it*

If drawings are worth keeping they are worth keeping right Why not keep them clean and flat and indexed so you can locate any one in a jiffy"

The Solution



"Y and E" Vertical Blue Print Cabinet No 430 carried in stock Table front when extended can be used as reference shelf or drawing board It is dust proof; drawings are kept flat, clean and smooth; indexed for quick reference.

In the "Y and E" Vertical Blue Print Cabinet, shown here, you can file 700 to 1,000 prints, indexed for instant reference The cabinet is dust proof; takes up but 3¾ sq. ft. of floor space The front is perfectly smooth and may be used as a handy reference table on which to examine contents or make memoranda or corrections

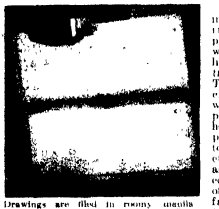
Its History

Two or three years ago D. J Burlingame, of Chicago, designed and patented a special cabinet for filing large prints in the Chicago Association of Commerce. Today we control the rights, and have changed and improved the cabinet until it is the finest on the market. It is truly the proper place for blue prints and drawings See it and you'll agree



Drawings can be removed from the cabinet without extending table front

The Manila Pocket



Drawings are filed in roomy manila pockets suspended from the top Imagine a big vertical file, and these you have it

The drawings are filed in manila pockets which are like big vertical folders They are closed half way up so prints are held in place, preventing torn edges, etc Pockets are supported by strips of hard wood fastened at the top Mighty handy.

How to Index

One big advantage of this cabinet is the ease and facility of locating a drawing when filed On the inner side of the cover are eight cards (printed both sides) held in permanent metal racks Cards are ruled for easy writing of index information, and each bears letters, A-B etc In stock cabinets the envelopes are numbered 1 to 20 If you are filing Mr. Brown's drawings in pocket 20, you'd write under B—"Brown—house drawings 20

What Could Be Simpler?

Contractors file blue prints, rough drawings and sketches

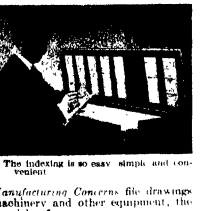
Engineers file their big prints and sketches.

Art Stores file prints, valuable sketches; indexby artist's name or subject.

Draft Departments of Manufacturing Concerns file drawings and prints of machinery and other equipment; the cabinet gives it quick reference

Chamber of Commerce—Industrial departments file city maps, sectional plats, etc.

Advertising Departments, Advertising Agents can use this cabinet to file large photos and drawings



The indexing is so easy simple and convenient

These cabinets are used in many other lines of work. If you have maps, drawings, prints etc., to file you need one, too

What One User Says

Our "Y and E" Vertical Blue Print Cabinet is entirely satisfactory For the purpose of keeping blue prints, maps and other papers free from dust and so indexed that they can be found instantly when needed, we don't believe this cabinet can be surpassed

H R HUMPHREY,
Industrial Commissioner,
The Chicago Association of Commerce

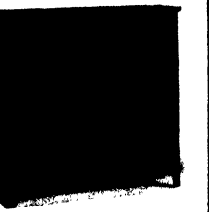
In a Nutshell

1—"Y and E" Vertical Blue Print Cabinet is dust-proof and air-tight

2—Will hold 700-1000 prints

3—Contains 20 strong manila pockets, suspended by two wood pieces at top

4—Prints are filed in pockets and thus kept clean, flat and smooth



Cabinet when closed is dust proof and compact, takes up minimum of floor space

5—All Prints are carefully indexed by name or number, as preferred.

6—Any print quickly findable by referring to index on inside of cover

7—Handiest known way of filing and indexing drawings, tracings, blue prints, sketches, maps, artist proofs etc

8—Widely used by architects, contractors, superintendents engineers and draughtsmen

9—Cabinets are carried in stock in two sizes No. 036 for drawings 40x36 or less, and No. 430 for drawings 44x30 or less—and in quartered and plain oak in "Y" and "E" standard golden finish

10—Cabinets of special sizes and in special finishes furnished to order Estimates on request (Advise drawing size and quantity to be filed)



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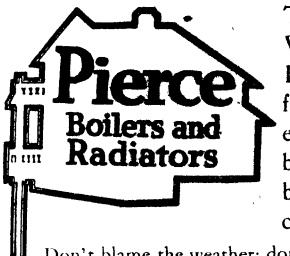
NEW YORK, 280 Broadway
CHICAGO, 21 S. Wabash Avenue
BOSTON, 98 Franklin Street
WASHINGTON, 614 Twelfth Street, N.W.

BRANCHES:

CLEVELAND, 611 Superior Ave., N. E
PHILADELPHIA, 914 Walnut Street

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SEE PAGE 259.

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Testing Before Buying

(Concluded from page 957.)

1909-1910, 19,885,217 pounds of silk were conditioned, and in the 4 years [illegible] 11,378,962 pounds. The moisture in silk varies with the climate and the morals of the seller. The normal amount is about eleven per cent. A moist situation can increase this three per cent or more. If in all the above stated American importations two per cent of excess moisture was paid for as silk, the loss to the buyers was over one million dollars. It is probable that all the conditioning houses of Europe receive as much as $500,000 for fees for services in thus examining raw silk.

But undoubtedly the largest patronage of the materials laboratories comes from the constructional industries. In these it is now quite generally recognised that the proper control of materials by specification and testing is a species of insurance upon the finished property. Considered thus the cost would be but one or two per cent of the material in place; but this percentage of cost is not charged annually as the fire insurance, but only once, and its beneficial influence endures for the lifetime of the structure. Moreover, a moral and legal value adheres in a work which, during its progress, has the reputation and proofs of being constructed only of carefully examined materials.

Chance of failure from defective material is reduced to a minimum, and if it does occur from other causes the possession of these proofs is invaluable. Not to be despised even by the financier are the æsthetic values.

In our own times architects in congested centers of population would seem to have entered upon an era that is unlike any of the past, and one that has inaugurated a school of its own. Whether this influence will persist, whether it will develop into more noble and ideal forms, more lasting monuments must rest with the technologists who study materials and adapt them for the use of architects, and also with the latter as they learn and utilize the knowledge. If this is not done we shall have early ruin, discouragement, defeat and a return to the more undoubted stability, if not beauty and usefulness, of the stone age of architecture.

Cast iron has been eliminated from our columnar structures, the steel used is carefully examined to insure the best quality, and the covering paints are chosen to secure the best protective value. Stone, tiling and impervious substances are sought for to protect the facades and roofs, but all of these materials have defects which research will conquer if the demand becomes insistent enough to bring the rewards.

When our laboratories of standards and of research founded by the government or by private wealth shall have been in operation a longer time, and the observers more numerous and more skilled, when international comparisons and exchanges of data shall be more frequent and general than now, the progress in these arts will be more rapid and beauty will spring from utility. We shall see these sciences which the æsthete sometimes considers of secondary importance really bringing about a restoration of beauty. This will be not alone by mere adornment and charm of variety caused by a wider choice of form and color, but most importantly by in spiring the pleasure that springs both from an impression of stability and grandeur and from contemplation of a work that harmonizes lightness with stability and fitness with gracefulness. Beauty, in fact, is a result we can long for and justly expect from these studies, not only beauty in architecture, but in the mural and sculptural arts, in textiles and in most products of human skill and handiwork. Then we shall enjoy our surroundings the more, for, as Ruskin has said, beauty has been appointed by the Deity to be one of the elements by which the human soul is continuously sustained.

Catalysis

(Concluded from page 958)

proportion of one to two, and the investment on capital invested in the plant and in the materials locked up in the process is diminished in the same proportion. It

[illegible] of the [illegible] we must [illegible] lytic material locked up in [illegible] which [illegible] amount [illegible] sample of this kind is [illegible] tact process for the manufacture [illegible] phuric acid, which gives [illegible] acid of high concentration [illegible] rather more compact than [illegible] old chamber process, even [illegible] careful purification of the [illegible] in the new process calls for [illegible] sive apparatus.

It would require a special [illegible] do justice to this most fine [illegible] important process, which represents [illegible] of the most striking applications [illegible] catalysis that have occurred in [illegible] chemistry within the last few [illegible] In a brief survey of the general [illegible] catalysis such as this article is [illegible] to present, it is impossible to [illegible] technical details, but one brief digression may be permitted, to bring before [illegible] reader an illustration of a recent [illegible] opment in the technique of the [illegible] process, especially as the principles involved have been discussed in these [illegible] in relation to operations in an entirely different field of applied science. [illegible] contact process, as distinguished from the chamber process, produces anhydrous sulphur trioxide, which is not ordinarily placed upon the market as such, but is converted into sulphuric acid by hydration. To the uninitiated it might appear that this hydration should be the easiest of all operations, inasmuch as it is well known to the first year's student in chemistry that SO3 possesses extreme affinity for water. In practice, however, it is found, that unless special precautions are taken, when the trioxide comes in contact with the absorbing bath, dense white fumes of sulphuric acid mist are formed, which are extremely difficult to condense. The reader may recall that Oliver Lodge's experiments on the precipitation of fogs by means of electric charges. Prof. F. G. Cottrell of the University of California has taken the line of experiment following in the steps of Lodge, with a view to condensing the fumes such as occur in various industrial processes, notably the sulphuric acid contact process. By the courtesy of Professor Cottrell and the editor of the *Journal of Industrial Chemistry*, I am enabled to reproduce here some photographs of the experimental installation for the condensation of sulphuric acid mist. The first picture (page 248) shows the apparatus with the gases from a converter passing through it untreated. The second picture shows the effect produced upon turning on the electric discharge. It will be observed that the precipitation of the acid mist is practically complete.

The mystery which surrounds the true nature of catalysis is not by any means a matter of purely academic interest. Technically it is felt in the fact that there is little or no general systematic method by which we can be guided in the selection of a suitable catalyzer for a given reaction. As the result of this, the discovery of such a body is very largely a matter of accident and good fortune. A rather striking example, which well illustrates this point, is quoted by Erunck in the description which he gives us of the evolution of the industrial process for the synthesis of indigo by the Badische Anilin und Sodafabrik. In the course of this process, which represents one of the most remarkable triumphs of modern industrial chemistry, it is necessary to oxidize naphthalene to phthalic acid. This oxidation at first offered difficulties. One day, however, a batch of the material quite unexpectedly yielded with ease to what appeared to be the usual treatment. The case seemed to baffle explanation, until finally the cause of the phenomenon was discovered in a broken socket, from which a small amount of mercury had escaped, and, mingling with the reacting substances, had produced by catalysis the effect desired, the rapid oxidation of the naphthalene by the sulphuric acid.

We have spoken so far only of organic

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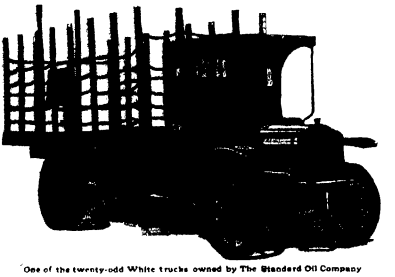
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ate by inanimate agencies. Of the greatest importance in technical work and for vital processes are the innumerable cases of organic catalysis, or, as it is commonly termed, fermentation. For certain lower organisms have the power of catalytically bringing about various chemical decompositions. Among such organisms we number some good friends, but also some of our most insidious foes. There are bacteria which act as scavengers, converting noisome waste products not only into inorganic salts, but at the same time into plant food. Others assist certain plants in extracting from the air the inert nitrogen, "fixing" it in a form available to the plant. Bacterial fermentation produces alcohol for beverages and for industrial use. And so on, the list might be prolonged almost indefinitely. Then there are those dread visitors, the disease germs, that come upon us unseen, and, stabbing in the dark, spare neither young nor old. They, too, probably do their work by catalytic action, producing deadly poisons within our body. In the triumph of modern medicine, the keenness of our natural eye has been so far increased by the assistance of the microscope, that we can now discern these diminutive and terrible aggressors. We know something, too, of their chemical means of warfare, and are learning to fight them with their own weapons.

Let us now return for a moment to the case of the crystal "germ," which initiates the formation of the solid from the liquid, for instance in a body of super-cooled water, or in a supersaturated solution of Glauber salt. This case presents a special feature, to which attention has not so far been called. It is the product itself which acts as catalyzer, or, in technical language, the case is one of "auto-catalysis." This particular form of the phenomenon is of peculiar interest owing to its close relation to a fundamental property of living matter. This relation is clearly brought out if we consider side by side a simple case of inorganic auto-catalysis and a typical example of its organic counterpart. On the one hand, then, we have before us say a super-saturated solution of Glauber salt, on the other hand, a vessel containing a sterilized infusion or other material suitable as a culture medium. Each of these two systems is quite stable if left undisturbed, and will retain its character indefinitely under such circumstances. But, introduce a vestige of a Glauber salt crystal into the one, or a minute quantity of a suitable bacterial germ into the other, and immediately a transformation sets in, giving rise in the first to a growth of crystals, and in the second to a growth of living matter. Furthermore, just as the same infusion is capable of producing a variety of different organisms, according to the particular germ with which it has been inoculated so a solution supersaturated with several salts will respond to each specific crystal germ introduced by the growth of the corresponding crystalline substance. In one respect, however, the two cases seem to differ. It is quite impossible, so far as is known to-day, to cause the growth of living matter in a bacterial culture medium except by the introduction of a "germ." Only life can give rise to life, within our knowledge. In the case of the crystal growth, it is often a comparatively easy matter, when no crystal germ is available, nevertheless to start crystallisation, either by increasing the degree of supersaturation of the solution (e. g. by cooling), or in some instances by mechanical agitation or analogous means. The organic chemist, however, knows that there are substances which are very refractory in resisting all attempts to crystallize them. Thus for instance, it is a rather rare occurrence for glycerine to assume the crystallized form even at very low winter temperatures. The distinction pointed out is therefore after all not so fundamental as may at first sight appear. For a more detailed discussion of this very interesting subject of the analogy between crystallization from a supersaturated solution and the origin of life, the reader may be referred to Ostwald's very stimulating series of lectures, published in English under the title of "Natural Philosophy."

For the sake of simplicity, and in or



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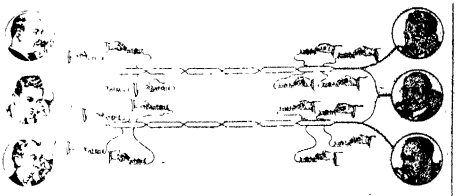
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While there is this joint use of trunk line plant by both companies, the telephone and telegraph services are distinct and different. The telephone system furnishes a circuit and lets you do your own talking. It furnishes a highway of communication. The telegraph company, on the other hand, receives your message and then transmits and delivers it without your further attention.

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Already the co-operation of the Western Union and the Bell Systems has resulted in better and more economical public service. Further improvements and economies are expected, until time and distance are annihilated by the universal use of electrical transmission for written or personal communication.

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der to bring out more clearly the analogy of the crystal "germ," we have chosen for our example a bacterial growth in a simple culture medium. The phenomenon of auto-catalytic growth is, however, of course, quite general in all living matter. Indeed, Wo. Ostwald and T. B. Robertson have shown that the curve representing the rate of growth of various organisms closely resembles in character that calculated for a certain type of inorganic auto-catalytic reaction. Just how much significance is to be attached to this resemblance, is perhaps an open question. Of the general auto-catalytic character of the growth of living matter, however, there can be little doubt

It is impossible in a short review of this kind to do justice to the entire field here broached. Much has been written on catalysis and probably still more remains to be said For a concise resumé, replete with reference to the literature on the subject, the reader can probably not do better than turn to J. W. Mellor's very excellent little volume "Chemical Statics and Dynamics," one of the series of text books of physical chemistry edited by Sir William Ramsay. It is the hope of the writer that enough of the subject has been presented here to give the reader a general idea of the nature of the phenomenon and of its important bearing upon a number of questions of the highest technical and vital interest

The Industrial Chemist.

(Concluded from page 203.)

For analysis of iron and coal, advantageous to know use of calorimeter

For analyses of miscellaneous materials used in manufacturing work position in research laboratory

Man needed who is familiar with heat treatment of steel and metallography of steel

Chemist experienced in analyses of iron and steel and steel products

Young man well acquainted with food and fermentation analyses

For regular analytical work, inclusive of mining precise apparatus work

Chemist to take charge of extensive salt works on the Pacific coast

Chemical engineer to design evaporating distilling and condensing machinery and to superintend its installation

Chemist trained in beet sugar and agricultural chemistry Much original research work Thorough training required

Good chemist strong, of good moral habits, for medicine company

Chemist to do experimental work in developing commercial products

Graduate of some school of accepted standing in chemistry analysis of oils, gums resins, petroleum products pigments coal, and boiler water Research later if man shows ability

Young graduate chemist for analytical work Must be an accurate analyst and able with proper assistance to do both chemical work and physical testing

Laboratory chemist Work will be mainly iron and steel

Man familiar with the manufacturing of paint

Experienced man for experimental work and satisfaction of processes

Assistant analytical chemist food and drug analyses

Several young chemists for routine work on iron and steel analyses

Instructor in mineralogy for university and analyst to department

Energetic chemist with working knowledge of electricity with good initiative and good chemical training

Chemist with knowledge of pharmacy, able to do analytical work

Demonstrating chemist who understands the use of liquid chlorine for bleaching

Several chemical engineers for factory

Bright young man with knowledge of chemistry and bacteriology

Chemist for research laboratory with, preferably, metallurgical training

Chemist with some experience in manufacturing of nitre-cake and sulphate of soda

Experienced sugar house chemist

Chemist for assistant in research laboratory

Assistant chemists in laboratory

Chemist well versed in the nitrating of cotton and the properties of amyl acetate.

Chemist for analytical tests and research work of a physical-chemical nature

Chemist able to keep ordinary accounts and to serve as understudy to the chief chemist.

Competent man needed to take charge of manufacture of tablets salts and hypodermics

Pharmaceutical chemist to take charge of laboratory, able to make fluid extracts, elixir tablets etc

Bacteriologist and analyst in private laboratory, to take charge of routine analyses

Chemist for investigation in making wood spirits of turpentine, well drilled in organic chemistry

Photometric and testing gas analyst.

Chemist for cotton seed products and fertilizers

These applications are for the most part for small men, and even so they do but constitute, probably, one one-thousandth part of the positions that are open to-day for competent men. And, even so, the call has but started to sell.

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that in the immediate future and for twenty years the demand for works chemists will far exceed the supply. The revolution in factory practice that is proceeding is the most amazing in the whole history of American industrial development. The factory of whatever type that does not possess at least one works chemist will be an anomaly.

The larger factory organizations are now rapidly establishing bureaus of research requiring the services of many chemists. It is as the heads, or chiefs, of such bureaus that men have some of the largest opportunities in contemporary industrial chemistry Even to-day salaries of from ten to forty thousand dollars a year are being paid to chiefs of research.

Equally attractive in opportunity is the profession of consulting chemist One of the most significant features of the International Congress of Applied Chemistry that met two years ago in London was the presence there of consulting chemists whose incomes derived from specialized knowledge in practical chemistry were princely The man who can make himself a supreme authority even in a very limited field of industrial chemistry has limitless opportunities for achievement and of adequate reward

Still again, a chemist, neglecting both positional and consultative work, may work simply as an investigator. In the past such a man was almost inevitably robbed To-day as a general rule he receives equitable treatment, particularly if he comes of good scientific antecedents

Finally, as one of the most significant illustrations of the spread of scientific ideas in industry, there should be cited the establishment at the Universities of Pittsburgh and Kansas of the system of Industrial Fellowships The University of Pittsburgh has received some eighty thousand dollars from various companies, the whole amount of which is to be expended in the next two years in salaries for chemist-investigators In the University of Kansas some thirty-five thousand dollars have been involved. All this money passes out of the direct control of the donating companies for chemical investigation

The Technically Trained Foreman

(Concluded from page 255)

making machine, rolling jack, glazing jack, buffing wheels, and measuring machine. Special rooms are also provided for finishing, drying and tacking. As will be noticed the equipment for this line of work is more extensive than the other. The reason for this is, that the National Association of Tanners are cooperating with the Institute in providing more extended courses in this branch of industry, which shows every sign that our manufacturing interests realize the importance of this kind of education

By the middle of the winter term each student has worked in all of the model factories and has finished his instruction in dyeing, so that for the remainder of the year his time is devoted entirely to that industry in which he intends to specialise

Like all new undertakings this course of instruction has been somewhat criticised, especially by those who have not taken the trouble to investigate the methods followed and the object to be attained It has been said that it is nonsense to teach a young man a little about soap, a little about dyeing, a little about paint, and a little about leather. This perhaps would be nonsense if it were all that the course accomplished, but such is not the case. Up to the time that the student begins to specialize it is not so much that he learns about any particular industry, but it is what he learns about operating typical machinery, handling men, assuming responsibility, and gaining self-reliance that counts In other words, he is brought in touch with manufacturing operation, he handles material on a sufficiently large scale to produce something which has a commercial value. If through carelessness or failure to follow directions he spoils a lot of goods it means an actual loss in dollars and cents which in a factory would be very apt to cost him his job. That this method develops self confidence is evident by the pride and interest which each foreman, and his men as well, take in the product manufactured, especially when the product is of fine quality, and it is also

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We could easily fill this space with touring experiences, all leading up to the same conclusion—hundreds of miles of absolutely unknown territory traveled without a single direction asked, even in the large cities. A couple will suffice.

The first week in June a millionaire manufacturer of Davenport, Iowa, while in Detroit, bought a popular priced car to drive himself " The first time he ever took hold of a steering wheel was on this car, in the outskirts of Detroit His lessons gave him the "bug" to such an extent that he determined to drive home to Davenport. So he bought an Official Route Book and a Warner and made the whole distance without asking a single question.

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gratifying to note the disappointment when the product is not up to the standard, or the cost of production exceeds the price received for the finished article.

When the student begins to specialize, however, a different condition obtains, and he then does learn, not a little, but very much about that particular industry into which he hopes to enter for his life's work It should be plainly understood that no school can turn out experienced paint makers, or expert tanners, but that the training received so fits young men that they can readily adapt themselves to the conditions encountered in the manufacturing plant.

Of the one hundred and two young men who have taken this course there are ninety-nine employed in chemical lines, of which number sixty are doing practical work Of the latter number seventeen are employed in tanneries, sixteen in paint and color works, and the remainder are scattered throughout other lines of industry These men hold positions as Managers, Assistant Managers, Superintendents, Assistant Superintendents, Foremen and helpers.

Although many of the graduates go into analytical lines we do not make this our aim, for we feel that that field belongs to the colleges and technical schools The one great object which is always uppermost and for which we are constantly striving is to train young men for responsible positions in the factory, where by reason of their technical training they will be able to work more intelligently and in sympathy with the chemist, who under present conditions often finds it impossible even to try out his ideas in a practical way owing to the non-receptive attitude taken by those who have the practical work in hand

We are a nation of vast resources and if we wish to conserve them we must improve our factory conditions. Not only must we have the trained chemist with his scientific and technical knowledge, but we must have technically trained and intelligent workmen as well. The foreman who works by rule-of-thumb is no better than a machine, but the man who uses the brains which God gave him and knows what he is doing will not only make a better product, but will be capable of grasping the details of the technical points involved

It is the humble opinion of the writer that the time is fast approaching when all positions of responsibility will be held by men who have received a technical education, either in the university, college, technical school, trade school, or vocational institution, and especially from those schools which aim to emphasize the practical side of the technical subjects they are endeavoring to teach; for then the foreman the superintendent, and the chemist can talk in a language familiar to them all, and the details will no longer be shrouded in mystery

An American Rotating Aviation Motor

THE present Gnôme rotating motor, which is so widely used on flying machines, is not a French invention in principle, as many suppose. In 1898 the first revolving cylinder motor made its appearance in this country, which was afterward embodied in the Adams-Farwell car.

The originators of that pioneer motor of its type have now brought out a 72-horse-power motor which revolves vertically. No carburetor is used. Gasoline is injected into each cylinder by a device which feeds exactly the same mixture to all cylinders. Hence it is possible to do away with the inlet valve and to employ one valve for both inlet and exhaust. Only air is drawn in by the suction stroke of the piston, and the gasoline is sprayed within the cylinder, where it is mixed with the charge of air before compression The single valve in the head of the cylinder can be made amply large to insure a full charge and a free exhaust

In order that the cam which controls the action of all five valves may be relieved from the heavy load of opening a large valve against high pressure at the time the exhaust takes place, the cylinders are provided with auxiliary exhaust ports, which are uncovered by the piston on its inward stroke. No check valves are required for these auxiliary ports. On the suction stroke, pure air,

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You don't feel it at all. The corn is forgotten until it comes out.

Go get it. Don't let corns torment you any more.

A in the picture is the soft B & B wax. It loosens the corn.
B protects the corn, stopping the pain at once.
C wraps around the toe. It is narrowed to be comfortable.
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and not a mixture of gas, is drawn in. The air aspired through the auxiliary ports and suction stroke becomes a part of the explosive mixture in the cylinder, and since it is constant in quantity, it does not affect the operation of the motor

The motor is controlled by regulating the amount of gasoline used. The only adjustment that may be construed as belonging to the carbureting system is the valve by which this control is accomplished.

To lubricate the motor, an oiler is employed which consists of a single rotary member, much resembling in form the cylinder of a revolver, with longitudinal chambers bored therein Each of these chambers carries a plunger which, as the cylinder revolves, is driven from end to end by two cams, thereby causing a small amount of oil to be drawn into each of the chambers at the bottom, and ejected into a corresponding tube at the top. An extra heavy grade of cylinder oil is thus supplied to the various bearings and to the cylinders, thereby obviating the necessity of splash lubrication, which in other rotating cylinder motors calls for the flooding with a great quantity of oil, and the consequent gumming of the valves and spoiling of the spark plugs

In order to insure against the accidental stoppage of the motor, two spark plugs are provided for each cylinder, as well as two independent ignition systems.

Instead of circular flanges, longitudinal flanges are employed, as the result of a series of experiments to determine the action of the air in circulating about the cylinders of a rotating motor Since the air is thrown off radially from the cylinder walls, it would seem that the logical arrangement of cooling ribs or flanges is that which has been adopted. There are structural advantages in placing the flanges in this way, for the cylinder is strengthened against tensile strain caused by the action of centrifugal force and the explosions

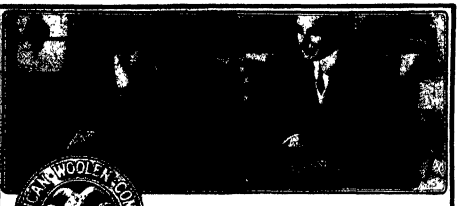
The material of which the motor is made is vanadium chrome nickel steel The bore is 6 inches and the stroke likewise 6 inches. The rating is 72 horse power by the A. L. A. M. formula (square the bore, multiply by the number of cylinders, and divide by 2½). On actual propeller tests it is claimed that more power than this has been developed Furthermore it is stated that a 9 foot 6-inch propeller, of 6 feet pitch, has been driven at 900 to 1,000 revolutions per minute

The makers state that only one gallon of lubricating oil is used to 20 gallons of gasoline instead of 1 to 4, or 1 to 9, which is found necessary with European motors

Moving Pictures of the Coronation

ACCORDING to a German trade paper devoted to the interests of the moving picture industry, the activities of the moving picture makers to obtain good films of the coronation were equal to the exertions of any of the newspapers to publish the fullest and best accounts of the ceremonies All told, we learn, fourteen firms sent 200 operators to the coronation They were well received and had to pay heavily for good positions, as much as $1,500 in one case It is said that not less than 10,000,000 feet of film were required, which was used up at a rate of about 200,000 feet an hour by each of the cameras

Many of the moving picture theater owners had made arrangements to exhibit the coronation films on the very evening of the coronation itself. Some of the railroads considerately placed special trains at the disposal of the manufacturers, and thus the films reached the provinces with astonishing rapidity The films were developed on board the trains and positives made immediately. On the very night of coronation day films were thrown upon the screens at Liverpool, Manchester, Birmingham and even in Paris The representative of a French firm, who took passage on the "Mauretania," developed his negatives and made his positives on board. Immediately on his arrival in America he distributed his films to the various film exchanges with whom he had made arrangements.



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TO MEET EVERY REQUIREMENT OF THE EXACTING SPORTSMAN, TOURIST OR MOTORIST

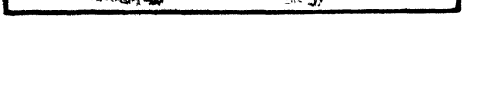
Forestry Cloth (Shade No. 65) as an out-door fabric is ideal, because dust and wind proof — sheds water — and being a beautiful shade of olive-green commends itself to the woodsmen, has been adopted by the U. S Government as standard for the Forestry Department Comes in several weights

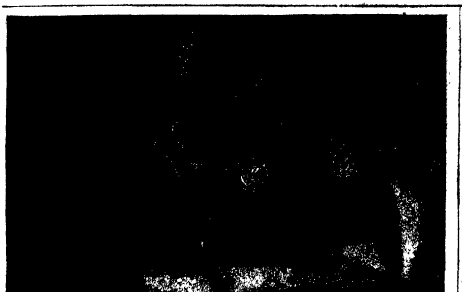
Quivaute Cloth — a fabric similar to the above in weave made in an attractive shade of light brown and especially suited for riding and driving clothes, motorists' apparel, outing suits and raincoats.

These cloths are highest grade, pure all wool worsted, closely woven, very durable and uniform in color.

Samples of *Forestry Cloth* and Quivaute Cloth sent upon request If you are unable to procure these fabrics from your Tailor, we will see that you are supplied upon receipt of price. When ordering specify fabric and number of yards desired. *Forestry Cloth* $2.75; Quivaute Cloth, $3.50 per yard

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This eighteenth year of the Haynes car is a year of triumph for the pioneer American builder of automobiles Last year automobile experts, and the public as a whole, declared the Haynes had reached the limit of quality production at a $2100 price It was hard to figure how any more automobile worth could be put into a car at the price of the splendid 1911 model, but there *is more* in the 1912 Haynes, and the price remains $2100.

The 1912 Haynes is not radically different from its recent predecessors. It is not radically better, but it does represent more all-round value than *anybody* has ever before been able to put into a car selling at the Haynes price.

The 1912 Haynes is a bigger car—120-inch wheel base: it's a roomier car—wider rear seat and more depth both in the tonneau and in front; it's a more powerful car—the 41x5½ motor gives forty to forty-five horse power: it's a safer car—larger brakes give one square inch of braking surface to every thirteen pounds of car and it is a snappier, more stylish car—the whole car is finished in black with seventeen hand-rubbed coats of paint, and the trimmings are of black enamel and nickel.

The 1912 Haynes is now ready for delivery. You can see them we models at our branches and agencies, or we will send you a catalogue and name of dealer nearest you. The line is complete, meeting every demand—5-passenger Touring, 40 h. p., $2100; 4-passenger, 40 h. p., Close-Couple, $2100; Colonial Coupe, 40 h. p., $2450; 7-passenger Touring, 50-60 h. p., $3000; 4-passenger Close-Couple, 50-60 h. p., $3000; Model 21 Limousine, 40 h. p., $2750; Model Y Limousine, 50-60 h. p., $3800. Complete regular equipment for all models is of the very highest class. Provision is made for the installation of electric lighting equipment at nominal cost. Address

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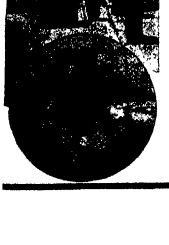
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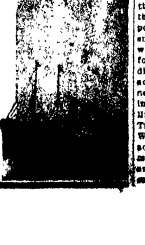
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Will leave New York, February 14th, 1912, arriving at Funchal (Madeira), February 21st; Gibraltar, February 23d; Algiers, February 24th; Villefranche (Nice), February 25th; Genoa, February 26th; Naples, February 28th, and Port Said, March 2d.

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Notes and Queries.

Kindly keep your queries on separate sheets of paper when corresponding about such matters as patents, subscriptions, books, etc. This will greatly facilitate answering your questions, as in many cases they have to be referred to experts. The full name and address should be given on every sheet. No attention will be paid to unsigned queries. Full lines to correspondents are printed from time to time and will be mailed on request.

(12533) Y. R. C. asks: In "Heavens in June" in your journal of June 3rd, it was stated that we could recognize Venus and Jupiter by the fact that planets do not twinkle. This I observed to be true. But according to your explanation given in query No. 12461, that distant lights twinkle because the strata of the intervening air change their refractive powers, it should not make any difference whether the light is from a planet or a star. Will you please explain it? A. The reason given by astronomers why planets do not twinkle is that they present apparent disks, and are not mere shining points as the stars are. Mercury, the smallest planet and the nearest to the sun, is always seen to be twinkling violently. This peculiarity of Mercury among the planets is due to its small size, so small that at its great distance from us it has no apparent disk, and its greater intrinsic brightness because of its nearness to the sun. See Todd's "New Astronomy," pages 92 and 313. We can furnish the book for $1.50.

(12534) F. A. C. says: Is it true, as I have often heard stated, that dry batteries will give better results (i. e., a better spark at same voltage) than will wet batteries; both batteries being in their best condition. Is this true and why? A. A dry cell is made to have a very low internal resistance and so to give a large number of amperes on short circuit It therefore is well adapted to give a very hot spark If a wet cell were made on the same lines it would give the same result. It is not the voltage of the cell which produces this result, but the amperes, and this is the quotient of the volts divided by the ohms in accordance with Ohm's well-known law.

(12535) W. L. S. asks: Has an article ever been published in the SCIENTIFIC AMERICAN describing a method of hypnotizing one's self and rendering one clairvoyant? Also do you know of any source of information that could furnish the desired data? A. We have had many valuable articles on hypnotism in our SUPPLEMENT. We name numbers 148, 299, 371, 587, 720, 756, 1047, 1056. We will send these papers for ten cents each We can also furnish you any book published upon the subject; we name Bramwell, "Hypnotism, Practice, and Theory," $4.50; "Hypnotism," by Moll, $1.50; "Hypnotism, How It is Done, Its Uses and Dangers," by Cocke, $1.50

(12536) C. R. asks: On the night of August 15th I observed a meteor in the southwestern sky which behaved different from any I ever before saw or heard of When first noticed it appeared a considerable distance to the left and above the apparent position of the planet Jupiter. At first it followed the usual wide course, moving toward the big planet across the sky. At the end of the long course the meteor turned sharply upward, its bright white light changing to a brilliant orange, quickly vanishing in a puff of black smoke Is it customary for meteors to behave in this way? What was the cause of such apparent erratic motions? Does the SCIENTIFIC AMERICAN sell any books on astronomy which would be worth while to own? If so, give prices, as I want to buy. A. While it may not be said to be customary for meteors to show the changes shown by the one you describe, still every sort of behavior is found in them Changing color and vanishing as if with a puff of smoke is not uncommon. We can supply you any book in print upon astronomy. You will find Prof. Todd's book very interesting and accurate. His "New Astronomy," price $1.50, is widely used as a text book, and his "Stars and Telescopes," price $3, is most interesting to anyone who looks at the heavens

(12537) H. R. G. asks: Will you please tell me what is the scientific explanation of the fact that a person can be lifted by the forefingers of two persons if they inhale at the same moment? A. It is safe to say that there is no scientific explanation needed for the fact that two persons can lift a person by their forefingers. The writer used to lift 150 pounds with one little finger, and feels no surprise that two persons should lift the same weight using four such straight fingers for the purpose. The inhaling of the breath diverts the attention of the persons from the act of lifting, and they usually say they do not lift at all. But to raise a person weighing 160 pounds, that weight must actually be lifted, and each finger must lift 40 pounds. This is a small weight for a forefinger to lift. We do not think there is any occult force in action here, but just a simple action of the muscular force. We have seen it done without any inhalation of breath at all, and just as easily as when inhaling the breath.

Science

Chinese and Japanese Bells.—Consul S. L. Gracey, stationed at Foochow, calls attention in the *Daily Consular Reports* to the soft and smooth tone of the bells in use at temples and monasteries in China and Japan. The quality of the tone is due not only to the use of excellent material, but also to the absence of iron clappers. The bells are never swung, but are always suspended in a fixed frame, and are sounded by striking them on the outer edge with a wooden mallet.

Masuchika Shimose.—Masuchika Shimose, who invented the high explosive to which the name Shimose powder was given by the Japanese navy, died on September 7th. He was professor of applied chemistry and was born in 1859. For several years he was superintendent of the ammunition department of the naval arsenal, during which time he made extensive researches in connection with explosives. His compound was adopted in 1893 by the Japanese navy, and for his services a decoration and a sum of money were granted to him.

Facts About Mastication.—The force required to crush an ordinary nut, such as one too often sees cracked between the back teeth, has been shown to be equal to a weight of more than 110 avoirdupois pounds, directly applied. The amount of saliva daily secreted by the average male adult is about 1¼ liters or 1.59 U. S. quarts. In thoroughly chewing 100 grammes of "Zwieback"—a kind of sweet toasted bread—there is needed half a liter (0.53 U. S. quart) of saliva; in masticating the same amount of apples, only 1.75 liter or 3.7 cubic inches; that is, only 8 per cent, or about one-twelfth as much.

A Shining Metal.—There is a legend among the peasants of Cornwall in England that at night there may be observed a faintly-shining mineral among the rocks brought from the mines. That this is not pure fancy has been proved by Prof. Strutt. A specimen of the mineral autunite, which is also found in Wales, was sent to him from Portugal because of its luminosity. He finds that it closely resembles artificially prepared salts of uranium, and that its luminosity is due to spontaneous radio-activity. The light it sheds is stronger than that of nitrate of uranium Upon parting with its water of crystallization the mineral loses its luminous property.

The Size of the Oceans.—The Pacific Ocean covers 68,000,000 square miles; the Atlantic 30,000,000; and the Indian Ocean, Arctic and Antarctic Oceans 42,000,000. To stow away the contents of the Pacific it would be necessary to fill a tank one mile long, one mile wide and one mile deep, every day for 440 years. Put in figures the Pacific holds in weight 948,000,000,000,000,000,000 tons. The Atlantic averages a depth of not quite three miles. Its waters weigh 325,000,000,000,000,000,000 tons, and a tank to contain them would have each of its sides 430 miles long. The figures of the other oceans are in the same startling proportions. It would take all the sea water in the world 2,000,000 years to flow over Niagara.

How We Ought To See.—Data have been gathered in Germany with reference to the distance at which persons may be recognized by their faces and figures. If one has good eyes, the Germans claim, one cannot recognize a person whom he has seen but once before at a greater distance than twenty-five meters (eighty-two feet). If the person is well-known to one, one may recognize him at from fifty to one hundred meters, and if it is a member of one's family, even at one hundred and fifty meters. The whites of the eyes may be seen at from twenty-seven to twenty-eight meters, and the eyes themselves at seventy-two to seventy-three meters. The different parts of the body and the slightest movements are distinguishable at ninety-one meters. The limbs show at one hundred and eighty-two meters. At five hundred and forty meters a moving man appears only as an indefinite form, and at seven hundred and twenty meters—2,361.6 feet—the movements of the body are no longer visible.

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Delightfully Simple, Inexpensive, Absolutely Perfect, Pure Water Supplied Under Any Desired Pressure. Operates on Pressure as Low as 10 Pounds per Square Inch. Will Pump Water to Any Height, Through Any Length of Pipe, by Simply Increasing Pressure. Does Not Freeze, Rust, Clog or Get Out of Order.

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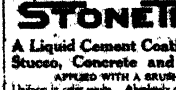
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Aeronautics

Fatal Aeroplane Accidents in America.—On September 2nd Captain John J. Frisbie, one of the most daring and best of our aviators, fell to his death in Kansas while making an exhibition flight. Frisbie did not wish to make the flight, but he did so to please the public. His machine, which was equipped with a Gnôme motor, is said to have turned completely over when flying in a gusty wind. On September 4th, Alexander McLeod of Winnipeg, Canada, fell from a Curtiss biplane while making a flight at Chicago. McLeod's neck was broken, and he was fatally injured.

The Transcontinental Flight.—The transcontinental flight for a prize of $50,000 offered by a New York newspaper, has drawn forth no less than eight entries to date. Besides Mr. Robert G. Fowler, the Wright pilot whom we mentioned in our last issue, the Wright aviators, Rodgers, Parmalee, and Atwood, and the Curtiss aviator, James J. Ward, are planning to compete in their biplanes, and Earl L. Ovington expects to attempt the flight in his Blériot monoplane. In addition to the above-mentioned aviators, Mr. James V. Martin expects to try for the prize in a new headless biplane of his own design, and Mr. A. V. Reyburn, Jr., of St. Louis, has also entered. Mr. Ward is making the chief effort to fly from New York and win the prize. He will be accompanied by a special train containing an extra machine and plenty of spare parts. The indications are that there will be a lively cross-country competition for this prize before the month is over.

Mr. Glenn Curtiss's Ideas on Aeroplane Development.—Glenn H. Curtiss has had more experience than any other man with regard to the naval aeroplane, and he has recently made a statement summarizing the points upon which the aeroplane needs improvement for military and naval use. He believes that the first requisite is the ability to fly under all sorts of weather conditions, especially in strong winds. His own machines have demonstrated their ability in this direction, as we have already noticed. The points of improvement given by Mr. Curtiss are the following: 1 Degree of safety when operated in rough weather. 2 Speed in altitude climbing. 3 Scope of vision of operator and passengers. 4 Facility for alighting on either land or water and rising from either at will. 5 Factors of safety in design and construction. 6 Weight carrying. In addition to these, further credits should be given for small extent of surface offered as a target, for ability of either occupant to operate the machine without inconvenience, for speed in packing and unpacking, and for facilities in launching the machine from a confined space.

Record Flights at the Boston Meet.—The Boston meet was brought to a close on September 6th after a number of record flights had been made. The chief of these was the 180 mile cross country race for monoplanes, with a $10,000 prize to the winner, which was flown on Labor Day. The course was from Boston to Nashua, N. H., to Worcester, Mass., Providence, R. I., and return to the aviation field at Squantum. Mr. Ovington, on his Blériot monoplane, and Arthur Stone on a Queen monoplane were the only competitors, while in a biplane race over the same course, Lieut. Milling, in a Curtiss, and Harry M. Atwood in a Wright, were the only competitors. Atwood carried his father as passenger, but only flew 12 miles before he was obliged to descend on account of motor trouble. The same was the case with Stone, who only covered about 10 miles before he was obliged to alight. Ovington completed the course in 3 hours and 4 minutes, alighting at each of the cities mentioned. Lieut. Milling lost his way before he reached Nashua and he was obliged to alight at Concord and inquire which way to go. Owing to this and other delays he did not finish the race until after dark. He was awarded the first prize of $7,500, his time for the flight being 5 hours and 23 minutes. Another feature of the meet was the winning of the 33-mile race to the Boston Light and back twice over, by Grahame-White in his Nieuport in 27-35 1/5. This is the fastest time ever made over this course.

"Fame Follows Where Everitt Goes"



The 1912 Self-Starting Everitt "Four-36" 106pc. Fully Equipped. $1500

The New Everitt Models—The "Six", The "Four" and the "Thirty" Are Ready For Your Inspection At A Nearby Dealer's—See Them

THE recent announcements of the 1912 Everitt have literally amazed the country. The values offered are so unusual and unexpected that it is little wonder their possibility has been freely doubted.

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Other manufacturers have frankly admitted this. They did not see how we *could* do it; they did not believe we *would* do it.

But the proofs are open to anyone. The affidavits of famous steel-makers; an inspection of our factory; the record of the men behind the car—most of all, its own test, in your hands—show conclusively that these cars have really "bridged the gap between the $1500 price and the $4000 quality."

Chrome-Nickel Steel Construction

To those who know anything of fine steels, no argument is needed to show the superiority of Chrome-Nickel. A Chrome-Nickel Steel car—as any engineer can tell you—is about three times the usual strength.

The new Everitt Six and Four-cylinder cars are built throughout of this incomparable material, making them well-nigh unbreakable and unwearable in service. So far as known, these are *the only cars*, selling below $4000, in which this matchless steel is used to any extent.

This material comes from two of the best producers of fine steels in this country—the Billings and Spencer Company, and the Crucible Steel Company of America, at a cost of nearly three times what "good automobile steel" commands.

The affidavits of these two great concerns—showing beyond question that the Everitt is entirely constructed of Chrome-Nickel Steel—have recently been reproduced word for word in our public announcements.

Every Desirable and Modern Feature

In addition, these cars are provided with a Compressed Air Self-Starter which starts the motor and pumps the tires. The wheels are big and massive, and provided with Demountable Rims. The design is clean-cut and handsome, with all levers and door-handles inside. Full equipment, with everything of the best, is included.

Except for size and number of cylinders, the new "Four" shown above, is practically a duplicate of the "Six". Both these cars, with the famous "Everitt Thirty," are beyond comparison from the standpoints of reliability and service.

We invite you to see these new models at your earliest opportunity. The brief specifications of the Everitt "Four-36" are as follows:

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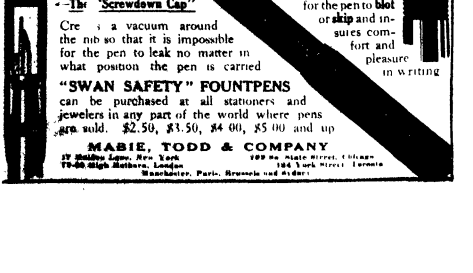
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AVIATION

The OCTOBER MAGAZINE NUMBER of the SCIENTIFIC AMERICAN ISSUE OF OCTOBER 14th, 1911

The next mid-month number of the Scientific American will bear the date, October 14th, 1911.

A large part of the number will be devoted to the more practical aspects of flying.



Of these aspects, perhaps the most dramatic, the one which interests the casual reader most, is the use of the flying machine in war. In an article entitled "Dropping Bombs from Aeroplanes", Lieut. Scott draws a vivid picture of the conflict of the future, and tells in what manner the soldier of the air will direct his course over an enemy's camp, and drop shrapnel upon the helpless troops beneath. The chief problem to be solved is that of directing the projectile accurately, which phase of the subject Lieut. Scott discusses with the fullness and directness that may be expected of a West Point man.

In three recent European races, Lieut. Conneau won $100,000. The sum is huge, but not nearly so huge as other figures in this newest of industries. In an article entitled "The Business Side of Aviation", Mr. Grover Cleveland Loening will tell what it costs to race, what a flight like that of Atwood's from St. Louis to New York means in dollars and cents, what enormous profits are made by the manufacturers of aviation motors and aeroplanes themselves.

Not until the engineer steps in and designs a machine which will fly fast with the least possible engine power will the aeroplane take its place as a pleasure vehicle which any one may use. Much scientific research is necessary before that time will come, to determine the best form of plane. What physicists are doing in the laboratories of great universities to solve that problem is revealed in an article which bears the title "Progress in Aerodynamics".

Every amateur who takes the most superficial interest in aviation considers himself competent to design an aeroplane. He knows nothing of the basic principles laid down by Langley, Chanute, Maxim and the Wright brothers. The result is machines that are aviation absurdities. In a merrily written and biting article, which is fittingly entitled "The Chamber of Horrors", these freaks are riddled.

Besides these articles on aviation, the mid-month number for October will contain the usual Scientific American material, abstracts from current periodicals, the inventor's department, and articles on recent achievements in science and industry.

The whole number will be incased in a colored cover by Mr. William Hamden Foster.

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SIXTY-SEVENTH YEAR

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THE WEEKLY JOURNAL OF PRACTICAL INFORMATION

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THE TWIN-SCREW VESSEL "HERALD" COALING THE LONDON & NORTH-WESTERN RAILWAY COMPANY'S MAIL STEAMER "ANGLIA"

[See page 274.]

SCIENTIFIC AMERICAN

Founded 1845

NEW YORK, SATURDAY, SEPTEMBER 23, 1911

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The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are strong, the articles short, and the facts authentic, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

The purpose of this journal is to record accurately, simply, and interestingly, the world's progress in scientific knowledge and industrial achievement.

Newspaper Heroism

THE true professional spirit is essentially modest, and among the highest type of professional men the good of the cause ranks higher than the gain of the individual. Pride of place and a laudable ambition to excel go side by side with a settled dislike of limelight exploitation and any form of newspaper notoriety. The ethical distinction between the trades and professions, which was so strongly accentuated in earlier days, and survives in certain parts of the world even to-day, was based originally upon the fact that the professional man was supposed to take up his life's work primarily because he loved both the profession and the people whom it might benefit. The personal gain which it brought was a secondary consideration. In this respect he was distinguished from the man of commerce, who bought and sold first and last for pecuniary gain. This ethical distinction or dividing line between the trades and professions has largely disappeared, and we are sufficiently optimistic to believe that it has been due to a filtration of the professional spirit into the commercial world.

A case in point occurred on the steamship "Carmania" when she recently put into Halifax for coal, and took advantage of the opportunity to make some minor repairs to her low-pressure turbine. A small leakage pipe, leading from the turbine to the condenser, had developed signs of weakness, and it became necessary to close certain gates which were inaccessible from the exterior of the engine. Ordinarily the turbines would have been allowed to cool down for repairs of this character, but in order to save from six to eight hours' time, which would be necessary for cooling off, the engineers decided to take off the manholes and send one of their number in to close the gates. This was done, and although the internal temperature was about 175 degrees, the task was successfully accomplished.

Upon the arrival of the ship in New York the event was seized upon by the daily press reporter, and a repair job which was designated by the engineers themselves as a mere matter of routine duty, was magnified into a story of stupendous heroism and magnificent devotion to duty which, although it may have provided an interesting quarter of an hour for the average citizen over his morning cup of coffee served with just provoke mingled consternation and ridicule among the engine room staff of the ship itself. Although a temperature of 175 degrees is scarcely that in which the average individual would choose to take even moderate exercise, it is a fact that in some engine rooms, especially in the tropics, temperatures have been known to run up not so very far from that given. On certain warships, when the hatches are battened down for battle practice, engine-room temperatures have been known to run up as high as 165 degrees.

A Safety Throttle for Locomotives.

PROMPTED by the too frequent instances of the disablement of locomotive engineers, either by accident, sickness or sudden death, a correspondent suggests that all locomotives should be equipped with some form of automatic "safety throttle," similar in its action to the control levers on the motors of the New York and Boston subways which automatically cut off the power the instant that the pressure of the driver's hand is removed.

Some years ago the editor rode in the cab of one of the then newly-instituted 18-hour trains to Chicago, when he covered some 1,500 miles of the round trip in the locomotive cab. He noticed that generally, and particularly at night, the engineer would keep one hand upon the throttle, the other upon the air brake lever. An emergency stop was made by the instant operation of these two levers. It would, of course, be possible by means of some source of power, *such as a pneumatically-controlled* piston, to shut off the steam and apply the brakes at the instant that the engineer's hand dropped from the throttle, either through accident or death. The objection to such an arrangement would be that there are times when he must remove his hand from the throttle, as for instance when it is necessary to sand the rails or open the cylinder drain cocks. On the other hand, the safety stop might be so arranged that it could be temporarily locked in position at the will of the engineer. In these days of huge boilers and large fire boxes, it becomes increasingly difficult for the fireman to supplement the watchfulness of the engineer. Locomotive engineers as a body would welcome, we believe, any practicable safeguard of this character, and it would materially add to the safety of railroad travel.

A German Criticism of the Panama Canal

THERE recently appeared in *Prometheus* a review of conditions and prospects at the Isthmus of Panama, which may probably be taken as representing the average German view of our stupendous task of cutting a waterway from the Atlantic to the Pacific at that point.

It takes but a cursory reading of the article, which will be found in full in the current issue of the SUPPLEMENT, to convey the impression that the writer is strongly pessimistic, both as to the completion of the canal in 1915, and as to its commercial utility after it has been thrown open for traffic. American reports of rapid progress are considered to be "very optimistic"; "extraordinary obstacles have yet to be overcome"; and "the officials responsible for the canal are beset by worries and fears."

Of the five kinds of difficulties—sanitary, financial, technical, geological, and commercial, enumerated by *Prometheus*, it is admitted that the Americans, who have proved themselves masters of the art of sanitation, have surmounted the hygienic and climatic obstacles which all but prevented the construction of the Panama Railway half a century ago. Seeing that the United States regards it as a matter of national honor to carry the work through, the financial basis of the enterprise is considered to be secure.

It is easy for any one who is familiar with the canal problem to predict the line of criticism which will be followed by any one who approaches the unusual geological and technical difficulties which the construction of the canal has opened up. In the present case, the security of the Gatun Dam and the permanence of the slopes of the Culebra Cut are called in question, but in neither case is any new light shed upon the subject, nor are any possibilities of failure suggested which have not been made the subject of careful study and practical experiment by the engineers in charge of the work. An experimental dam has demonstrated that the materials used in the hydraulically built-up Gatun Dam will be proof against seepage; and there is no evidence that any continuous and out-cropping strata of pervious material is to be found in either of the two underlying geological gorges, which will form part of the foundation upon which the dam will rest. Compacted by the great weight of the overlying dam, 120 feet in height, the underlying material, as revealed by hundreds of borings, is such that there is every reason to believe that the sub-surface, thoroughly compacted by the enormous weight of the overlying dam, will prove to be as water-tight as the dam itself. It is true, as *Prometheus* states, that "this construction has been much discussed and severely criticised in America"; but it should be noted that this criticism was made before the extensive borings and the carefully carried out tests had demonstrated to the satisfaction of our engineers that the structure will be stable and secure against seepage.

Regarding the unquestionably serious slides in the Culebra Cut, to which much attention is given, it is sufficient to say that these slides were expected and provided for in the estimate of final cost. The unstable character of the Culebra Mountain had been suggested by the experience of the French when they commenced the cutting, and further established by the borings made by the American engineers. An estimate of six million dollars was made by Col. Goethals to cover the probable extra cost of removing the slides. The latest advices from the Isthmus are to the effect that on the more important of the slides, the movement appears to have ceased, and that present indications show that the appropriation will be sufficient to cover any further movements of this character. Certainly it is not true that the "heavy rains and floods sometimes make the most careful and elaborate calculations utterly useless." Careful records of climatic conditions for many years past have made it possible for the engineers, by basing their calculations upon the maximum rainfall and maximum flood discharge, to make ample provision for every possible contingency.

Finally and inevitably, the writer in *Prometheus* brings to the front the old bugaboo of damage by possible earthquakes, although it is distinctly to his credit that, unlike some American critics, he impartially points to the fact that the Panama region is comparatively free from such violent earthquakes as frequently occur in Central America. The last earthquake of a violent character took place in 1621, nearly three hundred years ago, and since then the Isthmus of Panama has experienced only very slight shocks, the most notable of which occurred in 1882. It is our own belief that slight disturbances of this character would have no material effect either upon the earthen dams or the concrete locks. Furthermore, we believe that because of their great mass, not merely the dams, but the locks themselves, would pass through an earthquake of some severity without either fracture or displacement.

We are free to admit, however, that, when our critic comes to the question of the commercial future of the canal, he is much more to the point. He considers it doubtful if the Panama Canal is destined to become the "important artery of commerce and the worthy rival of the Suez Canal that it is designed to be," believing that it makes its appearance too late to render to civilization the service that it might have rendered at an earlier date in the history of the commercial world. Had the canal always existed, the history of development might have been very different, the northeastern part of the Pacific Ocean would not have remained almost unknown until the middle of the nineteenth century, and the route of traffic between Europe and Australia and eastern Asia would have been via Panama, and would have become so established that it could scarcely have been diverted by the construction of the Suez Canal. But the development of the present trade routes has been based on the absence of a Panama Canal, and the great question is, how far can the opening of this waterway serve as a diversion?

The writer believes that the existence of the eleven trans-continental roads in Canada and the United States, and the recent opening of similar routes across South America, to say nothing of the excellent Tehuantepec Railway, have largely removed the trade necessities which, in former years, called so loudly for the construction of the Panama waterway. Very significant is his comparison of the values in millions of dollars of merchandise which was shipped from American ports to both American and foreign ports, via Panama and Tehuantepec, in successive years from 1907 to 1910. In 1906-7 the value for Panama was $9,600,000, in 1909-10 this had risen to $12,800,000. The value for the Tehuantepec Railway for five and one-third months in 1906-7 (the year of opening), was $11,450,000, and in 1909 to 1910 this had risen for the twelve months to the astonishing total of $69,600,000.

How far the forecast of this German review will prove to be correct, time alone can tell. It is our opinion that the advantages of shipment from port to port, without breaking bulk, will prove to be too great for successful competition either by our own trans-continental railroads, or those of Mexico and Central and South America. The appearance of this ably-written article, however, is another proof of the careful study which foreign nations are making of the commercial aspects of the canal. It is quite a question whether our own commercial bodies and the federal government are giving this subject the early attention which it requires. If the general commerce of the United States and the interests of its merchant marine are to reap the legitimate fruits of this great national undertaking, we should take early steps to safeguard our interests by suitable legislation. It would be perfectly proper to pass a law extending to all commerce between United States ports on the Atlantic and Pacific by way of the canal, those benefits which are secured by our present coast-wise traffic—in other words, Congress should recognize such traffic between American ports via the Canal as forming part of our coast-wise traffic by excluding all foreign ships from participation therein. The passage of a law to this effect would unquestionably prove to be a most effective means for promoting the upbuilding of the American merchant marine.

Henry Walter Nernst

A Great Physical Chemist

By Prof. William J. Humphreys, United States Weather Bureau

THE present director of the Physico-Chemical Institute of the University of Berlin, Prof Henry Walter Nernst, was born at Briesen, West Prussia, June 25th, 1864. He is, therefore, a much younger man than the volume and importance of his work would lead one to suspect.

Intimate glimpses of a scientific man's daily life are often full of interest, especially when they reveal peculiarities or seeming eccentricities due to the nature and intensity of his work. In the present instance, however, these peculiarities will be left to the discussion of his intimate friends, whom, doubtless, they sometimes amuse but never offend For the rest of us the name Nernst calls to mind chiefly a number of important contributions to the science of physical chemistry, and hence it is with these alone that the following is concerned.

In order to get a proper appreciation of Nernst's contributions to human knowledge, it is necessary briefly to review the cultivation of that fertile field of science that lies midway between the chemistry of Lavoisier and the physics of Newton

As a matter of fact there is not now, and never has been, a sharp boundary between physics and chemistry. Hence a great mass of information that to-day would be grouped under the general heading, "Physical Chemistry," was accumulated long before any one ever thought of the above compromise title for it. Physical chemistry, then, in the sense of a knowledge of the physical properties of compounds, is not a new science The melting and boiling points of many substances, their specific heats, atomic and molecular volumes, viscosities, spectra, powers to refract light, to rotate the plane of polarization, and the like, were long ago studied, as were also the changes in these properties owing to the addition or substitution of one or more elements

The object of the earlier experimenters was exactly the same as that of the ablest of the later investigators All sought, as every student of nature must, to *co-ordinate* apparently isolated facts through broad generalizations, or the assignment of them to a common cause But while the experimental facts discovered by the earlier workers are of the greatest importance, only empirical and hence merely approximate relations were found.

The glory of the newer physical chemistry, that which justifies its claim to a position among the sciences, is the freedom of its laws from mere empiricism, and the exactness with which it enables one to calculate results by rigid mathematical processes It is to this branch of chemistry, the branch that might even be termed mathematical chemistry, that Nernst has chiefly contributed It must not be supposed, however, that he was the founder of this our newest science, for there are others, especially Ostwald, van't Hoff, and Arrhenius, with prior claims to that honor; but he has been and still is one of its chief builders.

One of Nernst's earliest contributions to physical chemistry was a rational explanation of the mutual effect of salts upon each other's solubility It had long been known that in many cases two salts markedly interfere with each other's solubility in water, while others do not so interfere; but no satisfactory explanation had been offered for this phenomenon, nor was it possible, with a knowledge of the substances themselves, to predict what effect either would have upon the solution of the other. In this case, however, as often happens, the data necessary and sufficient to a complete solution of the problem were at hand, but it was Nernst who had the inspiration and the ability to use as premises the law of mass action, as developed by Guldberg and Waage, and Arrhenius's theory of electrolytic dissociation, and from them logically to deduce the exact cause and numerical extent of the effect of one salt on the solution of another

Another of Nernst's many contributions to our knowledge is an explanation of why any dissolved substance, as cane sugar, for instance, gradually spreads or diffuses throughout the medium in which it is dissolved Here use was made of the laws of osmotic pressure as formulated by van't Hoff—laws that in every particular are analogous to the laws of gas pressure.

Just as difference in gas density leads to gas diffusion, so does difference in concentration of a dissolved substance lead to its diffusion through the medium in which it is dissolved Hence the distribution of osmotic pressure throughout a given solution determines both the direction and velocity of diffusion

During recent years the investigation of chemical equalibra at high temperatures has occupied most of Nernst's attention As every one knows, the properties of substances depend upon temperature. Up to a certain temperature iron, for instance, is easily magnetised, while at higher temperatures it is but slightly magnetic At ordinary temperatures rubber is exceedingly flexible and elastic, but at the temperatures of liquid air it is as brittle as glass And so it is with other substances, their properties are profoundly modified when the temperature is greatly changed, so that to know a substance thoroughly is to know its properties at all temperatures Nor are the physical changes with temperature more pronounced than are the chemical. Substances that combine at one temperature decompose at another, and qualities that are in a state of chemical equilibrium at one temperature are thrown out of balance by heating or cooling Hence change in temperature furnishes unlimited studies for the physical chemist—studies to which Nernst and his students have given the most attention, but with results which, while valuable, necessarily are still incomplete The subject is so vast and so difficult that it will require years of work approximately to complete it

Probably the general public, since it cares more for an art that serves its needs than it does for the science that rendered the art possible, knows of Nernst chiefly, if not solely, as the inventor of the electric glower that bears his name This, however, like practically all other discoveries worth while, was the outcome, or, more exactly, a by-product of a purely scientific investigation, a careful study of the electrical conductivity of solid electrolytes In the course of this work it was found that the oxides of certain rare elements possess properties that adapt them to economical use in electrical illumination This was the always necessary discovery, the rest, in rendering the glower practicable, was but the ingenious combination of things already known.

To the scientific world, however, Nernst is best known as the man who first developed a satisfactory theory of the action of the primary electric cell, a theory that enables one to calculate beforehand just what electro motive force will be generated by a given combination of elements and solutions

The theory in question is based on three things, namely

(a) van't Hoff's laws of osmotic pressure or tendency of a dissolved substance to move from places of greater to places of less concentration

(b) The electrolytic dissociation theory of Arrhenius, which accounts for certain properties of dissolved salts on the assumption that they are more or less broken down into their constituent parts and that these individual parts are electrified

(c) Nernst's theory of solution tension or the assumption that any metal, when placed in a liquid, even a solution of one of its own salts dissolves to a certain extent, just as a liquid evaporates

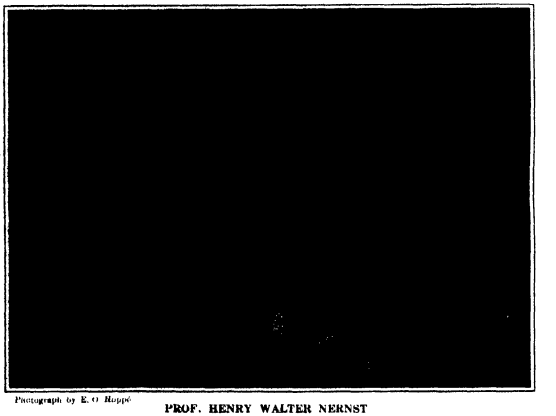
The theory of the action of primary cells not only accounted for the actions of all known cells of this nature, but even suggested previously untried combinations and foretold their action

An exceedingly simple cell but one that illustrates the theory, consists of two zinc rods dipping, the one into a concentrated, the other into a dilute water solution of zinc chloride The tendency of the zinc to dissolve into the water—its solution tension

Is the same in the two cases, but the osmotic pressure of the zinc ions furnished by the zinc chloride is greater in the concentrated than in the dilute solution Hence since the osmotic pressure and the solution tension are in opposite directions, a *state of equilibrium* requires a larger number of zinc particles to be dissolved from the zinc bar in the weak solution than from the one in the strong solution But each zinc particle carries with it a definite charge of positive electricity, and consequently both zinc rods are left negatively charged though the one in the dilute solution is more strongly charged than is the one in the concentrated solution Therefore when the two zinc rods are connected by means of an electrical conductor and the circuit is otherwise properly completed, a current flows from the less negatively to the more negatively charged rod outside the solutions, and in the reverse direction within the solutions This of course destroys the balance, in both solutions, between the solution tension and osmotic pressure In the diluted solution the advantage, after the balance is destroyed, is on the side of the solution tension, while in the more concentrated solution it is with the osmotic pressure Hence zinc is dissolved and added to the dilute solution from the rod that is in it and at the same time an equal amount removed from the other solution and deposited on the rod it contains, till, in the end the two solutions are of equal strength

At all times, and in all similar cells, the electro motive force is directly proportional to the logarithm of the difference between the two osmotic pressures and is numerically calculable

Such, then, are some of Nernst's important contributions to science, and there is every reason, judging from his industry, ability and position to expect still others of great value



Photograph by E. O. Hoppé

PROF. HENRY WALTER NERNST

New Life Preserver

RECENT consular reports describe a new form of life preserver, which it is proposed to introduce into the German Navy It consists of two swimming cushions bound together by straps and arranged to lie upon the breast and back The novel feature of the apparatus is an electric lamp, which is worn on the forehead The lamp burns 3 or 4 hours and is provided with a reflector which throws its light for a distance of several hundred yards at night The life preserver can be buckled on in 5 seconds

Artificial Life

II. Making the Non-Living Do the Work of the Living

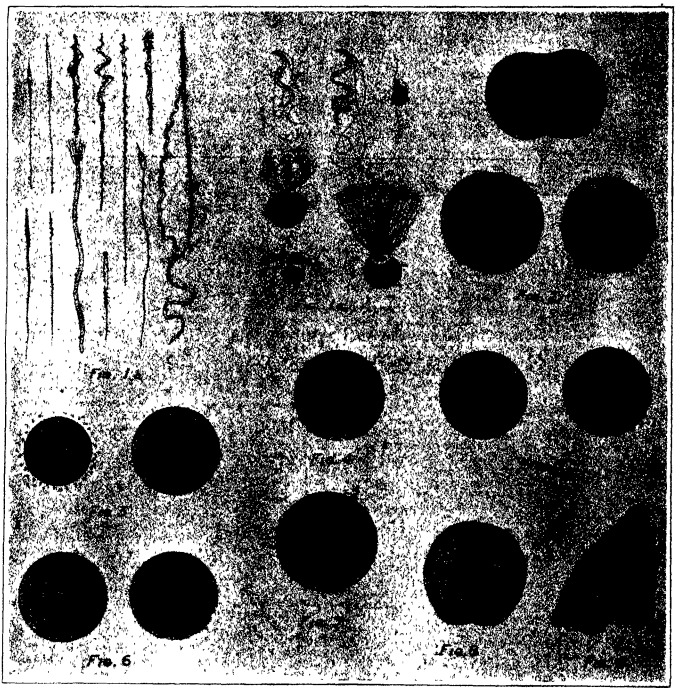
By Benjamin C. Gruenberg

We have seen that the body of scientific research which has to do with what is popularly termed "artificial life" takes on two distinct phases.* The first has to do with the creation of an artificial system or "machine" which behaves more or less like a living body, or like the living substance called "protoplasm." The second has to do with causing eggs to develop without being fertilized—"artificial parthenogenesis."

Before the discovery of the sperm in the seventeenth century, the nature of fertilization was absolutely unknown. It was in 1677 that the Dutch scientist Lieuwenhoek first saw the sperms of certain animals, but these swimming cells were at first regarded as parasites. The assumption among men of science was that the essential thing in fertilization was the fluid in which the sperms float. But the Italian monk Spallanzani, who was in some ways ahead of his time in his methods, filtered some spermatic fluid and showed that the sperms were the essential factors. This was more than a hundred years after the little "animalcules" had been discovered and still nothing could be known of the nature of fertilization, because nothing was known of the nature of the egg. After the establishment of the "cell theory" of the structure of living things in 1838-39 it was possible to get the notion that the egg is a *cell*; and a few years later (1845) the actual union of sperm and egg cells was directly observed, although the sperm was not yet recognized as being also a cell until twenty years later. During all these years, however, there was an abundance of speculation. This concerned itself with two major problems which overlap in parts. The first is: how does a hen's egg, for example, become metamorphosed into a chick? The second is: what is the share of each parent in the developing egg?

The first of these questions *could* not be answered in the latter part of the eighteenth century when speculation probably reached the high-water mark. There were two leading theories, with endless argument and debate. According to one theory the egg contained within itself a minute duplicate of the parent, and that this simply grew and developed. The extreme exponent of this "preformation theory" was the French naturalist, Charles Bonnet, at whose hands it developed into the absurdity that the parent bore these eggs with their preformed minute embryos while she was still herself in the egg, and so on indefinitely to the beginning of life. This doctrine was later abandoned by Bonnet, and had very few adherents. But, as we shall see, there was more in it than its strongest advocates ever suspected. The alternative view was that the egg started as a body without any definite structure, and developed the complex structure gradually. This idea of "epigenesis" was forwarded by Caspar Friedrich Wolff, who had the sense to abandon speculation and resorted to observing what could actually be seen in the developing hen's egg. But this doctrine did not carry satisfactory conviction.

The second question above referred to, that of the share of each parent in the developing egg, was also chiefly the subject for speculation and dispute. According to one school, the essential thing is the egg; the sperm serves merely as a stimulus for development. According to the other, the sperm is the essential thing, the egg merely supplies the nutriment for its development. Since 1875, however, we know that both elements enter into the make-up of the developing cells. In this year Oscar Hertwig and other biologists were able to observe directly the union of elements from the egg nucleus with elements from the sperm nucleus (Fig 2).



1a, Sperms of various plants. 1b, Sperms and eggs of various animals. 2. Fusion of nuclear elements from sperm and egg in fertilization. 3a, Unfertilized sea-urchin egg surrounded by sperms. 3b, The same after the entrance of a sperm and the formation of a "fertilization membrane."—After Loeb. 4. Beginning of the first nuclear division in fertilized egg.—After Loeb. 5. Completion of the first cell division in the segmentation of the fertilized egg.—After Loeb. 6. Four-cell and eight-cell stages in segmentation of the egg.—After Loeb. 7. Hollow ball of cells; the "blastula" stage in the development of the sea urchin and other animals.—After Loeb. 8. Two-layered cup of cells, the "gastrula" stage in the development of the sea-urchin and of other animals.—After Loeb. 9. The "pluteus" stage in the development of the sea-urchin larva.—After Loeb.

EGGS AND THEIR DEVELOPMENT

The debate between preformation and epigenesis has now no real meaning. Epigenesis is true in the sense that the fertilized egg from which the organism develops does not contain any preformed structure corresponding to the anatomy of the plant or animal into which it is to develop. On the other hand, the preformation theory was true in this sense: the fertilized egg cell contains elements that were present in the parents, which in turn derived them from their parents and so on indefinitely. In other words, the question that these speculations attempted to answer is in reality two questions: one has to do with the mechanics of development, the other has to do with heredity. The fact of fertilization has also this double aspect: it introduces into the egg the elements that make up the heredity from the male parent; and it starts the activity of the egg that leads to development.

These two aspects of fertilization have been experimentally demonstrated in a number of ways. The relation to heredity is shown by the fact of hybridization; indeed, it is through the study of hybrids that we have in recent years gathered the bulk of what we know about heredity. That the elements which "bear the heredity," or determine in some way the character of the organism, are carried by the nucleus was shown in an experiment by Boveri.

He cut the eggs (unfertilized) of sea-urchins, so that some pieces were without nuclear matter. These pieces he placed in sea water containing the sperms of another species of sea-urchin; the sperms fused with pieces of egg protoplasm. The egg began to develop, and when it got far enough along to be identified, it turned out to have the characters of only its male parent. As the nucleus cannot be removed from a sperm-cell without killing it (since the sperm is practically all nucleus) the reciprocal experiment cannot be performed. But the same results are obtained if an egg is made to develop without fertilization.

There are many animals and plants whose eggs normally develop without fertilization—either regularly, or under special conditions. For example, plant lice produce during the warm weather large numbers of eggs which develop into organisms like the mother without being fertilized, although another series of eggs, produced in the fall, cannot develop without fertilization. The same is true of certain species of "water fleas." The queen bee sometimes lays eggs that develop without being fertilized; these always develop into drones, and occasionally a worker-bee lays eggs which also develop without fertilization. This phenomenon is called *parthenogenesis*, and attempts to produce parthenogenetic development artificially have been made for a long time as it was expected that by this means we could get a clue to the physico-chemical

(Continued on page 283.)

*See *Scientific American*, September 9th, 1911.

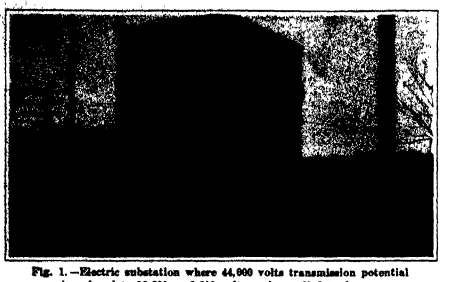


Fig. 1.—Electric substation where 44,000 volts transmission potential is reduced to 13,200 or 6,600 volts and supplied to farmers on lateral branch circuits.

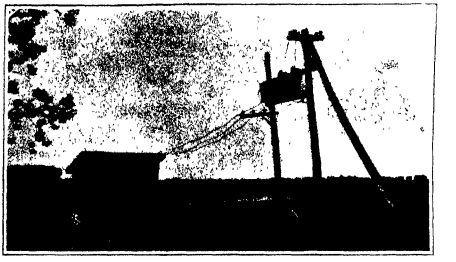


Fig. 2.—Alternating current motor driving irrigation pump fed by 2,200 volt farmer service through transformers which reduce the potential to 200 volts at the motor terminals.

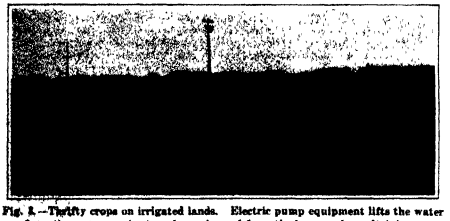


Fig. 3.—Thrifty crops on irrigated lands. Electric pump equipment lifts the water from the water service trench nearby and from the low meadow adjoining.

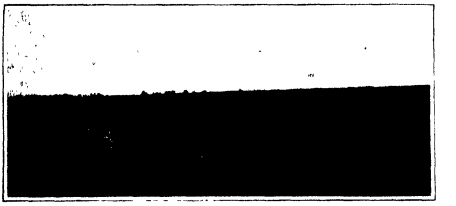


Fig. 4.—An excellent hay crop on a low meadow land drained by the electric pump equipment shown in Fig. 3.

Central Station Current for Farms

Advantages of Introducing Electricity into Rural Districts

By T. Commerford Martin and Putnam A Bates

UP to the present time, with 6,000 central station companies in the United States, there has never been a company or plant established to supply electricity to a farming region Perhaps there never will be Conditions in the central station industry have changed so rapidly in thirty years that electrical supply, once the peculiar enjoyment of residents in a limited city area is now available, from the one source, over hundreds of square miles The Boston Edison company, which began twenty-five years ago with a little area of perhaps half a mile around Faneuil Hall, now covers a large part of Massachusetts with its circuits, and has many farm supply problems on its hands. Around Chicago, the North Shore Electric Company furnishes 24-hour current to a population of 250,000, in an area of 1,200 square miles, reaching 71 cities and towns, and some hamlets with barely 100 people. It has already many farmers on its books, and will soon have many more on its lines. The Public Service Company of New Jersey covers with its circuits the whole of the northern part of the State. Out in California, from the Sierras, electrical energy is fed to San Francisco over 200 miles away, and the circuits of the one system embracing more than half the counties in the State, are availed of already by many a farmer who never expects to have a railway track laid in front of his barn yard It has been proposed to throw into 25 or 30 plants, the generating capacity of all the 400 existing central stations of New York State, because it is so easy now to distribute electricity that is made economically in great quantity. In England, the idea has boldly been put forward by Ferranti of using in about 100 central stations 60 million tons of coal, to supply the whole country, farmers included, with electricity at as low a price as ¼ cent per kilowatt hour—1 1/3 horsepower for an hour for half a farthing. Here in varying instances we have reality and dream, but all emphasizing the immense fact that electricity has ceased to be the servant merely of the city population, and now regards as within its reach any populated district where poles can be set and wires strung.

It is needless to go into the technical details of the process of engineering and invention to which this expansion must be attributed. Three main factors are involved, namely, the adoption of the alternating current, the utilization of water powers, and the resort to higher pressures of current. Of all these changes the farmer is especially the beneficiary at present, and destined to be even more so in the near future. The methods of supply have been tried out and firmly established The questions now confronting the central station manager, and already being dealt with by him in a great many instances are those of specific local distribution and service Sometimes the farmer has still to consider the problem merely for himself The farmer may install his own private electric generating plant, or several neighbors might band together and construct a power station of their own, each being served on the co-operative plan The most extensive use of electricity, however, in the rural or farming districts will, unquestionably, come as a development of present central station systems or the organization of companies having as their prime object, the serving of farmers' needs, through well planned electric plants located in the heart of the agricultural sections

During 1910-11 a canvass was made by a committee, specially appointed by the National Electric Light Association, to investigate the work of the various central stations in its membership in developing and caring for the electric power and lighting service to farms and in rural districts The result of this canvass was embodied in a report prepared by this rural electric service committee, of which Mr J G Learned was chairman, and presented before the National Electric Light Association's annual convention, May 29th, 1911. The evidence brought out in the report is most interesting and encouraging

Interesting data and valuable suggestions are, therefore, now before us on this new problem of extending central station electric service to the farmer In mapping out territory, the central station can no longer regard the outlying sections as of no immediate concern. They are to be reckoned with, and preparations should be under way to develop this business along lines that would insure handling it on such a basis as will give satisfaction to the farmer, and be profitable to the service company

It is clear, from the reports of several electric plants, where the rural business has been developed along good engineering lines and the farmer assisted in the solution of his somewhat complex mechanical farm problems, that this service is profitable Other central station companies are now making elaborate plans for carrying out methods of farm supply

The uses to which electricity can be advantageously applied in rural districts are many, and far more in fact than one would at first suppose. For reasons of safety and labor saving, the need for electricity is really greater in farming districts than in the more densely populated sections owing to the comparative isolation and consequent difficulty in obtaining labor. In the agricultural sections where stock farming is carried on or where there is considerable water to be pumped for irrigation purposes the use of electric power is well recognized as a decided betterment and it is in such districts, largely, that one will find the greatest opportunity for immediate progress

Broadly stated, the stock breeding and stock feeding districts require more power than truck gardening districts A stock farm requires to have conveniently within its reach at least 25 horsepower for feed grinding ensilage cutting, threshing pumping and a variety of similar uses The operation of dairies and creameries also requires considerable power and is an inviting field for the use of electricity

Naturally, the farmer is not compelled to use electricity, for there are several types of agricultural power apparatus utilizing steam oil heated air or other source of energy, which may usually be employed at a somewhat less first cost but the convenience, absence of risk and cleanliness of electric service are features which he values It is not necessary therefore to exert much effort in explaining the advantage of electricity, but the question is on what basis shall the service be supplied?

The conditions incident to the supply of electricity in the rural or farming districts differ so materially from those in the towns and cities that when the "farm" is considered, one is in the habit of regarding the proposition as undesirable, because one does not clearly see the manner in which such service may be economically rendered nor the extensive uses to which electricity may be applied in agriculture This ignorance is not a universal condition by any means but it is illustrative of the atmosphere surrounding many central-stations, located adjacent to good farming sections

In northern Colorado, we find a progressive company that apparently has attacked the problem in the right manner, and some of the characteristic features of the service supplied are illustrated in the accompanying photographs In the center of the more thickly settled sections, sub or distributing stations of the type shown in Fig 1 are erected the object being to locate points to which to build heavy distribution feeder lines and from these substations as centers to feed out lateral branches

This system embodies good engineering methods

and makes the current transmission costs such that for farmer business the same rates are charged as those asked within the towns, the only difference being that a minimum charge is made to insure a reasonable return for the extra investment in the pole lines, the first cost of which this central station company finds it agreeable to bear

The planning of this system has been carefully done and the company's policy is to encourage the utilization of its current The soliciting agents are trained in the uses to which electricity may be efficiently applied in farming and their success in securing results and business rests solely on their power to convince the farmers of the merit of each idea suggested.

It is quite natural that the rural consumers will require more individual attention from electrical solicitors, owing to the entire reliance of the farmer on this source for information This makes farmers somewhat more expensive to care for as customers, but in the period of development it is money well spent as friendship is created or cemented and new uses are found for current

An especially desirable feature of the farmers' service is the fact that the power or principal portion of their current requirement is entirely during the day time, which makes a tendency to balance up the load on the power station without adding to the "peak" load conditions It is therefore, obvious that many plants in smaller cities can supply farms during the day and their urban customers at night, from the same generators

Figs 2, 3 and 4 illustrate water electrically pumped, for irrigation purposes, which is an important field for the use of power in any agricultural section

Fig 2 shows a small inexpensive housing for the electric pumping plant, which elevates the water from a reservoir, a corner of which is shown in the background The water is delivered from the pump through a system of trenches upon an acreage of sugar beets In nearly all western States it is impossible to raise fruit, grain or garden crops without the aid of irrigation Everywhere crops would gain if irrigation were more general

Gravity irrigation is not always possible, due to the level of the land with respect to the water source To irrigate these high lands, which are often more valuable than the lower lands, it is necessary to raise the water by pumping.

A general view of one of these electric pumping equipments is illustrated in Fig. 3, while Fig. 4 shows quite another condition, in that the land of this particular field is so low that water would naturally collect in places, forming marshes The pumping equipment seen in Fig. 3 is utilized to keep this field drained during the season of irrigation; and the large field of potatoes—the foreground of the illustration—receives the benefit of this water

The central station system above referred to, and of which these illustrations are photographs, would be entirely appropriate as a means for mastering the farmers' electric service problem in any locality, and while the uses to which electricity may be applied differ in the various localities, these illustrations are especially significant The more extensive use of irrigating methods and power applications for general purposes must be adopted in successful farming systems of the future This fact at once suggests a new field for the central station service that will no longer be neglected.

It was the introduction of electric motors that enabled manufacturers of all classes to determine definitely their power costs The results thus obtained, through the elimination of belting and shafting losses and by measuring directly effective power used, were surprising.

On the farm, the advantages of such a change lie in another direction The saving in power is not so important, for the amount of energy needed for this purpose is never so great as in the manufacturing establishment The "ever ready" feature of the electric motor is here its chief advantage. Moreover oils and other combustible fuels, useful as they are, always introduce a decided additional fire risk wherever used, and of necessity farms are isolated in outlying districts away from organized fire protection Small power engines, using gas or oil fuel, may be placed at a distance from buildings when in operation, which of course is safer, but not so convenient The danger, however, cannot be so readily lessened in the use of oil lamps, matches and lanterns, nor is it very convenient to have to go outside to a point distant from the central buildings whenever power work is done.

It is the inconvenience of things that often spells failure for farmers. With a minimum of labor at command and a maximum of work to do throughout most seasons of the year, a direct saving in time of getting ready on each operation is all important.

From this point of view, therefore, the utilization of central station electricity for farming sections within striking distance of established power houses is ideal.

The central station manager and the farmer have different "angles of attack," but in reality their interests are the same It takes time, however, to size up correctly a new situation of this kind, and this fact accounts for the tardy development of electrical matters in rural districts.

The successful farmer of to-day is vastly different from the farmer of a generation ago. He operates, maintains and develops his farm with the care and shrewdness of a business man. He analyses his soil with the sole purpose of determining or of adapting to it the kind of crops best adapted to its characteristics and conditions.

He realizes that his stock must no longer trample tons of fodder under foot during the feeding season. Instead, he must cut the roughage and feed it in such manner that there will be little waste. The result of adopting such an obviously better method is success.

All this, however, takes power, and the old time tread mill is too awkward to harmonize with the situation under the improved conditions. Power machinery, therefore, becomes a necessity, and the electric motor is ever the dream of the man who wishes to be abreast of the times.

The matter of finance has yet to be mastered by most farmers, and central station men must remember this when arranging for the farmer's initial investment It will be policy to find a way to provide the line wires, transformers and meters, but cutting and hauling poles is a farmer's work and one can well leave this to him. He is often a skilful mechanician, familiar with the technique of a trade, and he or his sons take just as kindly to the handling of a dynamo or motor as they do to the operation of an automobile The main thing to do in introducing electrical applications on the farm is to utilize—not in the city but on the spot—all these latent possibilities.

A New System of Bunkering Steamships

The "Herald" and Her Performances

By F. C. Coleman

ONE of the latest developments in the bunkering of steamers is represented in the "Herald," a twin-screw coaling vessel shown in the photographs The "Herald" is fitted on the Holland-Johnston system with two elevators, and has a speed through the water of 6 knots The capacity of the vessel is 400 tons of coal, and the output 100 tons per hour per elevator i. e, 200 tons per hour for the vessel Our frontispiece shows the "Herald" bunkering the London & North-Western Railway Company's mail steamer "Anglia" and gives a clear idea of the construction of the vessel The coal is carried in pockets or compartments on each side of the vessel Between the compartments and extending nearly from one end of the coaler to the other, is a longitudinal passage up and down which the movable elevators are free to travel The system is novel and differs from other coaling methods inasmuch as though the "Herald" has only two elevators, larger vessels fitted in the same way might have three, four or five elevators, and with each of these elevators having an output of 100 tons per hour, it would be possible for a vessel so fitted to discharge herself at the rate of 500 tons per hour Large ocean liners served by large vessels of the "Herald" type, one on either side of the liner, such as the "Mauretania" or "Lusitania" and the big vessels of the White Star Line, could thus be coaled at the rate of 1,000 tons per hour

A thousand tons per hour may appear a very large quantity of coal to transfer from barge to steamer, and it can only be done by a system such as that on which the "Herald" is constructed, because to attempt to pass that quantity of coal down one shoot, or even two shoots, would mean that the discharge would have to be so rapid that the delivery of it could not properly be taken In the "Herald" system, however, different shoots are put through the side bunker doors in different parts of the vessel and coaling is thus going on simultaneously in practically all parts of the vessel's bunkers, consequently, the only delay with this method will be at the final trimming in the top of the bunkers, which must always be a slow operation

The elevators may be moved from any one point in the trunk to another, being carried by the trucks on rails, which are shown in the photographs In addition to this flexibility of the positions of the elevators, the barge itself can, of course, be moved, consequently there is no doubt that any vessel with side bunker doors may be coaled by this design of plant

When supplying coal to vessels provided with center bunker hatches instead of shoots, conveyors are put into operation for the purpose With other systems of coaling a great drawback is experienced with the fine coal dust or dirt which gets blown about by the wind and covers the vessel being coaled from end to end with dirt Compare these systems with the method of loading the London & North-Western Railway Company's mail steamer "Anglia," by the "Herald," and it will be seen that the complete absence of dust in the case is remarkable. Coaling by means of the "Herald" is a very clean operation No dust whatever gets on board the vessel being coaled.

The elevators are driven by a very ingenious multiple gear in the top pentagon drum, the small engine necessary for the purpose being contained at the head of the elevator between the top and the bottom trunks The exhaust steam from this engine is admitted into the head of the elevator in a suitable position, and is directed along the shoots into the vessel's bunker doors. The illustration shows the steam It was found by experience that coal dust is carried straight into the vessel's bunkers with the steam, thus insuring an extremely clean method of coaling steamers. It is stated that the steam does not in any way wet the coal.

With two elevators, the crew of the "Herald" consists of the master, the engineer, the assistant engineer, a fireman and three deck hands. This crew is sufficient to navigate her and do all that is necessary in connection with the bunkering of steamers. The salient features claimed for this bunkering system are: Flexibility as regards the shoots, cleanliness, rapidity and economy.

The Brooks Comet

By Prof. W. R. Brooks

THE new comet discovered in July by Dr. William R. Brooks, director of the Smith Observatory, Geneva, N Y., is now visible to the naked eye, and in a very favorable position for observation on the western side of Pegasus. The comet has moved up through the northern part of Cygnus, and on September 10th was about 20 degrees northwest of Vega, the brilliant star in the constellation Lyra, and now overhead in the early evening This was its greatest north declination, about 57 degrees From this place the comet is moving first westerly, then southwesterly as it speeds toward the sun.

The following ephemeris will show the comet's track through the northwestern heavens. Those not having telescopes with graduated circles, can plot these positions upon a good star atlas, and thus get the comet's relative place to the well marked stars in its course:

September.	R. A.	N Declination.
13	17 hrs. 10 min.	+57 deg 9 min.
17	16 " 18 "	55 " 42 "
21	15 " 31 "	53 " 90 "
25	14 " 51 "	49 " 21 "
29	14 " 17 "	44 " 56 "
October.		
3	13 " 49 "	40 " 6 "
7	13 " 26 "	34 " 51 "

The comet was nearest the earth on September 17th, when its distance was 45,000,000 miles. While the comet is visible to the naked eye, an opera or field glass will add to the pleasure of the observation.

Correspondence

[The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.]

Octave Chanute and H. T. Ricketts—A Sidelight

To the Editor of the SCIENTIFIC AMERICAN:

The very appreciative article on Octave Chanute by Prof. Zahm, in your issue of May 13th, recalls an interesting coincidence occurring not far from the commencement of certain close relations between the writer and Mr. Chanute during the last eighteen years of his life.

One morning in the early summer of 1896 Mr. Chanute inquired, somewhat quizzically, but in his usual serious and methodical manner, as to a young doctor who might not be too busy or too dignified to accompany him—for a consideration—on an expedition where he, the doctor, would be expected to do cooking during the few spare moments when he was not engaged in the professional duty of setting broken limbs.

This inquiry was typical of Mr. Chanute's customary way of launching an enterprise—foresightedness, economy of service, shrewd calculation of adequate margins of safety, were but outcomes of his instinct and distinguished training as a bridge engineer. Having tried out his air planes and kites among the tin cans and sand lots at the foot of Huron Street, he was preparing for his gliding experiments at Dune Park, Ind. With the fate of Otto Lilienthal fresh in his mind, he did not propose to let the members of his little company smash their bones without having some representative of the coroner available. It was a part of his spirit of cautious frugality that had he been spiritually minded he would have proceeded just as methodically to secure the services of a chaplain willing to take on a side line of washing while waiting for emergencies.

I knew Mr Chanute too well not to receive his request in the same spirit of courtly gravity in which it was made. And here is where the coincidence came in—I sent with him a solemn-faced conscientious student of medicine then helping me in my office, who was as single-minded a crusader in his own sphere of science as was Octave Chanute in his. What Howard Ricketts did not know about cooking, his temporary employer—a Frenchman and an epicure—informed me, would have filled a large Creole cook book, and as a surgeon he never had a tryout on Herring's or Avery's legs. But looked up even then in my young friend's breast was the purest, most deeply religious and unselfish love of science with which I have ever been privileged to come into intimate contact. Ricketts had no money, he cared nothing for it except as a means toward achieving his ambition to become an independent thinker in the sphere of pathological biology. He sat up nights with his ideas until his health was ruined, and his friends began to think him obsessed; perhaps he was a little so on commonplace subjects, but it was the obsession of preoccupation with connected thought, a form of mental peculiarity uncommon enough to seem queer to most of us, who are willing—*post hoc*—to admit that genius is usually a form of successful queerness.

Curious, was it not, that the lives of these two great serious and clean-minded scientists should have touched thus semi-comically and casually, only to drift presently apart again without influence upon or understanding of each other. Ricketts always thought "flying" was the one really jocular event of his life, and expected to eventually hear of his patron's incarceration for too lavish expenditure of money on box kites. Mr. Chanute associated Ricketts with nothing but spoiled meals, and pursued the disagreeable subject no farther—of what use was biology to the mathematician? And so each of these productive nineteenth century materialists thought the other a hopeless, useless visionary!

Yet Ricketts, like Chanute, "dreamed true," and his brief life with its tragic end—a last willing offering to his great goddess—was crowded full of those undramatisable epics of the modern laboratory that recall to us, if we have but the logical imagination to see them in their true stature, the heroic lives of early explorers, patriots, or religious enthusiasts. Pasteur and *Metschnikoff* gave him of their inspiration and technique. Animated by their methods, he struck out into new-world fields and returned with or finally sent back fresh contributions to science, destined also to prove of inestimable practical value to humanity. His original studies in pathological biology have never been equaled on this continent. His discoveries in blastomycosis gave him early recognition, and won for him an appointment at the University of Chicago. He spent three years studying the hitherto mysterious "tick fever" of the Rocky Mountains, and placed its etiology and pathology on a firm foundation. His experimental work in the immunity of organs received world-wide recognition and won for him in 1910, when barely thirty-eight years of age, the appointment to the chair of pathology at the University of Pennsylvania. As an especial mark of honor, the appointment carried with it a year's preliminary *freedom* for research work *at a full salary*, before entering upon active teaching service. As his final tribute to science he gave his life at its meridian in exchange for a knowledge of the secret sources of Mexican typhus. But not before that knowledge had matured from theory into fact, and the life history of the *micro-organism of the disease* lay *unfolded* before him under the microscope and in the culture medium. The Mexican government co-operated liberally with him during his work, and since his death in 1910 has given him unstinted recognition in an appreciative state paper transmitting his records to this country. We have now for the first time a complete biological and morphological history of the bacillus of typhus fever—a filth disease transmitted from human to human through the *intervention of the body louse* as an intermediate host. These records, with others of importance made by the same hand, have just been edited and published for the University of Chicago* and the Chicago Pathological Society.

It is not difficult for one who knew both of these natures well to see why they repelled and misunderstood each other. Their method in dealing with and their mental attitude toward, facts were from opposite poles. Ricketts's method was intuitive and highly imaginative—an old-fashioned dreamer working backward from theories and ideals to facts. He saw the truth correctly but intuitively, the facts came inevitably but later. Chanute collected facts during a lifetime of mature and precise mathematical thinking, and by methods of pure induction arrived step by step at correctly demonstrated conclusions, eventually beyond even the insane dreams of Darius Green. And yet he also was an unselfish idealist, as is abundantly evidenced by his refusal to accept the commercial advantages which his basic patent on the biplane undoubtedly gave him. The several hundreds of unpublished letters, full of technical details and mathematical calculations, which passed between him and the Wright brothers, and which are now in the possession of the Chanute estate, would indicate that his interest and his equity in the machine-driven biplane, while not at all tainted with commercialism, were vastly more than passing and casual. The reported saying that he "turned up" or "happened to drop in" at Dayton or Kittyhawk in 1901 cut him deeply and was scant recognition when viewed in the light of this unique and instructive correspondence between two great scientific men. The secret of this interest is an open one to those who know the mainsprings of his life and character. That secret, after his modest fortune was acquired, was an abstract and impersonal devotion—incapable of jealousy—to the pursuits and achievements of pure science as apart from material gain and advancement. A motive power common enough in the old world, and still more so under the *ancien regime*—the day of Newton and Franklin, of Laplace and Priestly, of Humboldt and Goethe but not commonly to be reckoned with amid the commercialism of present-day American life.

In the midst of and a recognized factor in contemporary supply and demand of modern railroad necessities, he still preserved unchanged the manner and family life of the French gentleman of the eighteenth century. Refinement, honesty, idealism, gentleness, all were his; yet he was full of fire in manner, spirit and inspiration. He was modest, yet he knew and gave himself his full value and dignity, as many of his letters abundantly show. In his seventy-ninth year his keen eyes sparkled like a boy's, and his wit was still as caustic as Montaigne's. On his death bed he corrected letters and telegrams with an enjoyment in the ultimate refinement of words that was altogether French. A many-sided nature in which were joined the pure philosophic altruism of the eighteenth century with the keen love for productive mathematics of the most modern American.

An early competence was won by strict business methods; then followed "retired leisure that in trim gardens takes its pleasure," only the gardens were the Illinois and Indiana sand dunes, and the leisure was an industrious but impersonal life in the fourth floor of a city house, surrounded by models and stuffed winged creatures and an abundant library of mathematical and engineering literature. The product of these voluntary labors, which he gave unselfishly to the world, showed as a net resultant all that was correct winnowed by patient experiment from a thousand ventures incorrect in their entirety. The Chanute biplane model, in its simplicity of line and principle, is a type of all those products of matured "genius" which are really the resultants of skillful elimination of the unnecessary and illusory. The accident of bodily age prevented personal flight. The accident of five years' delay in the development of the gasoline motor alone prevented the complete equipment of an otherwise perfect model.

It has been among the great privileges of my professional life to have had intimate contact with and to have formed an early appreciation of the value of these two great lives—lives so unlike in the details of their working out and surroundings, and yet so fundamentally similar in devotion to abstract science and in the altruistic determination to give largely and unselfishly that humanity might be the gainer.

Chicago, Ill. W. H. ARNOLD, M. D.

* Contributions to *Medical Science* by H. T. Ricketts, Univ. of Chicago Press, 1911.

Why Left-hand Mold-board Plows are Used

To the Editor of the SCIENTIFIC AMERICAN:

The following might be of interest to you in regard to the short article about mold boards for plows in the SCIENTIFIC AMERICAN of June 17th, page 603.

As far as the work done by the plow is concerned, there is, of course, no difference between a left hand and a right hand mold-board plow. The choice between the two depends, however, on the manner in which the team (two horses or mules) is driven or guided. If a *single* line is used, it is customary to connect it to the left (lead) horse, in which case the team is entirely led by this horse and by one line (*single* connection between the left horse and driver).

After the first furrow has been made, it in itself is the best guide for the team, and since the second horse (right hand horse as seen from the plow) is entirely guided by the "lead" horse the latter should walk in the furrow. This arrangement however, is possible only with a *left hand* mold board plow.

With one horse plows, or when the team is driven by a double line, it makes theoretically no difference whatever whether the plow has a left hand mold-board or a right hand mold-board.

Washington, D. C. F. A. WELBY.

Who Saw This Meteor Train?

To the Editor of the SCIENTIFIC AMERICAN:

On the night of September 4th, I noticed extending across the heavens at New City, N. Y. what I think must have been a "persistent meteor train" as recently described in the SCIENTIFIC AMERICAN. It first attracted my attention at about ten minutes past eight and was then in the northern sky in the form of a large circular arc not unlike a rainbow, but of much greater radius of curvature and extending almost completely across the sky from west to east.

The train drifted rather rapidly in a southerly direction and apparently straightened out as it reached the zenith, remaining perfectly straight until it was lost to view at a few minutes after nine.

The atmosphere was perfectly clear, the sky absolutely cloudless and the moon nearly full, shone brightly in the southern sky. At first I thought it was a peculiar cloud formation but it apparently had a luminosity of its own and someone remarked to me that, "It looks like the stuff of which the aurora borealis is made." Stars were plainly visible through the luminous mist and as it crossed the Square of Pegasus I noticed that it was almost as wide as the square, its length I estimated was 135 degrees or over.

As the streak crossed the moon's disk the section in front of the moon was made invisible by the bright light but on each side the segments were still plainly visible although considerably narrower than when at first observed and still in a straight line.

I would be very much interested to know whether this peculiar luminous streak was seen by other persons and whether it has been reported by anyone who knows what it was. EDGAR PEARCE.

New York.

The National Tree of China

THE tung, or wood oil, tree is worthily named the national tree of China. It is stately in appearance, with smooth green bark and wide-spreading branches, affording a fine shade. It bears a fruit resembling a shell bark hickory nut, but as large as a small orange. Each nut contains three triangular seeds similar to small Brazil nuts. The oil is pressed from these seeds, and the refuse is used as a fertilizer. The oil is used principally for polishing wood work and dressing leather. Considerable quantities are exported.

The wood of the tung tree is used for making musical instruments, fine boxes and the framework of small houses. It is believed that this tree might flourish in warmer parts of the United States.

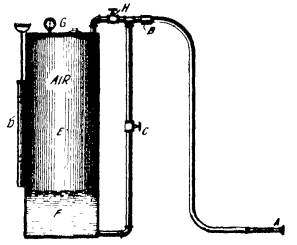
Suggestions for the Workshop

Ingenious Expedients of Resourceful Mechanics

Gasoline and Compressed Air for Cleaning

By J. E. N.

It is a common practice in automobile shops to use gasoline and compressed air to clean the dirt from otherwise inaccessible parts of an automobile, the apparatus employed requires a specially made nozzle connected with a double line of hose. The apparatus illustrated in the accompanying engraving, which was made by a friend of the writer, accomplishes practically the same result in a simpler manner. It consists of a galvanized tank *E* provided with a tube, soldered into it at the top, and another one at the bottom. These tubes are fitted with valves shown at *C* and *H*. The tubes are joined and are connected by means of a ¾ inch hose *B* of any suitable length, say twenty feet, to a nozzle *A*. The nozzle should be provided with a quarter-inch aperture and a flared outlet. A bicycle pump *D* is connected with the tank



Gasoline and air tank for cleaning automobiles.

at one side and a pressure gage *G* is secured to the top. In use, a gallon of gasoline is poured into the tank, as indicated at *F*, and then the pump is operated to produce a pressure of several pounds in the tank. The valves *C* and *H* may now be opened to such an extent as to permit a small quantity of gasoline and a comparatively large quantity of air to flow though the hose and the nozzle *A* may be directed to spray the parts which need cleaning. A single gallon of gasoline and a few strokes of the air pump have been found sufficient to clean thoroughly a single automobile. This type of apparatus cannot compete in efficiency with that used in automobile shops, but it is a practical device for a private garage.

How to Make an Engine Crank

By Albert F. Bishop

The task of making an engine crank is by no means beyond the abilities of the average amateur mechanic. The following directions will be found comparatively simple.

Take a piece of steel 2 inches thick, 5 inches wide and of a length to suit the purpose. A thin paste made of chalk dust and water may be spread over the metal and when dry it will provide an excellent surface for taking the lines of a sharp lead pencil. The crank may be laid out on this surface to the exact size required. The lines indicated in the accompanying

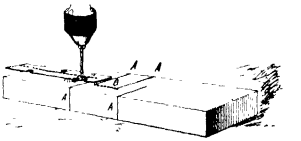


Fig. 1.—Cutting out a crank shaft.

drawing at *A* (Fig. 1) can be cut with a power saw. The cuts running lengthwise of the piece can be made to better advantage by drilling, although the two long cuts might be made by the power band saw. To facilitate the operation of drilling, a jig should be made of cold rolled steel 1/16 inch thick, 2 inches wide and about a foot in length. Drill holes in this piece in a perfectly straight line, spacing the holes as close together as possible without letting one cut into the other. This jig need not be hardened unless a large number of cranks are to be drilled. The piece should be attached to the surface of the steel plate by means of three machine screws. Now, the workman can proceed with his drilling and if the holes have been laid out nicely in the jig, the steel can be separated without much trouble after drilling.

After the crank has been cut out roughly in this manner it may be centered on the ends and turned in the lathe. The tool should be sharpened with considerable bevel and made to cut deep but thin chips, taking off nearly the whole corner at the first cut. This procedure will do away with a great deal of knocking. The cranked shaft should be roughed out at first, leaving plenty of stock for the finishing cut. For turning the crank pin, make a flange of the form indicated at *B* (Fig. 2) with two ears at the outer end, as shown at *D*. The machining on this casting is simple. It consists in facing the flange and boring it out to receive the crankshaft. The flange is clamped to the face plate and a bolt at *C* acts as a pivot, so that adjustment up or down can be secured by tapping the piece lightly with a hammer. The straps are then bolted securely. Lateral adjustment is attained with two set screws indicated at *E*. Two more set screws will serve to hold the shaft firmly in the neck of the flange. A counterbalance *F* may be strapped or bolted to the face plate.

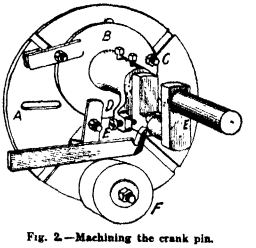
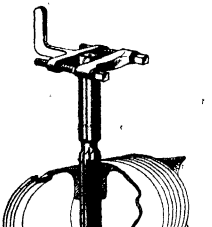


Fig. 2.—Machining the crank pin.

Enlarging a Reamed Hole

By R. P. Albert

When a mechanic desires to enlarge by several thousandths of an inch a hole which has already been reamed with a standard reamer, he can readily do so by wrapping paper around the tool, covering about three-quarters of its circumference and



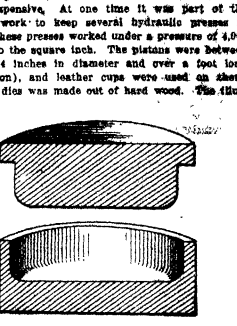
Enlarging a reamed hole.

leaving several cutting edges bare. The paper should be carried around with the reamer when the tool is in use. Graphite or the lead of a pencil should be rubbed on the outer surface of the paper to serve as a lubricant when the reamer is rotated.

A Leather Cup Die

By J. E. Noble

Men who have much work to do around hydraulic presses know how annoying it is to find they are out of cup leathers just when they are in a hurry for one. The price charged for cup leathers by some dealers is out of all proportion to the material that is in the cup and the labor required to turn them out. The iron dies generally used to make cup leathers are also rather expensive. At one time it was part of the writer's work to keep several hydraulic presses in order. These presses worked under a pressure of 4,000 pounds to the square inch. The pistons were between 12 and 14 inches in diameter and over a foot long (solid iron), and leather cups were used on them. A set of dies was made out of hard wood. The illustration shows a sectional view of them. They were turned out on a lathe. The concave part was turned out to the size of the cylinder in which the piston worked, and the convex part was turned down to a diameter one-half inch smaller. The leather was cut to a diameter twice that of the piston plus twice the depth of the depression in the die. It was moistened in tepid water for a few minutes, and then pressed in the dies. With a heavy weight to provide the necessary compression the leather was left for several hours. A single pair of dies was used for two years, at the end of which time they were apparently as good as ever.



Wooden dies for cup leathers.

Combination Pipe and Monkey Wrench

A common monkey wrench may easily be adapted for use as a pipe wrench for emergency work, thus making it unnecessary to carry two wrenches in the tool kit. Take an ordinary monkey wrench and mill a small groove in the fixed jaw, as shown at *A*. This groove should be milled on a taper as shown.

When the wrench is to be used on a pipe, take an old piece of bolt or stud, harden the threaded parts and place the stud in the groove that has been milled in the jaw of the wrench. This will prevent the wrench from slipping around the pipe while in use.



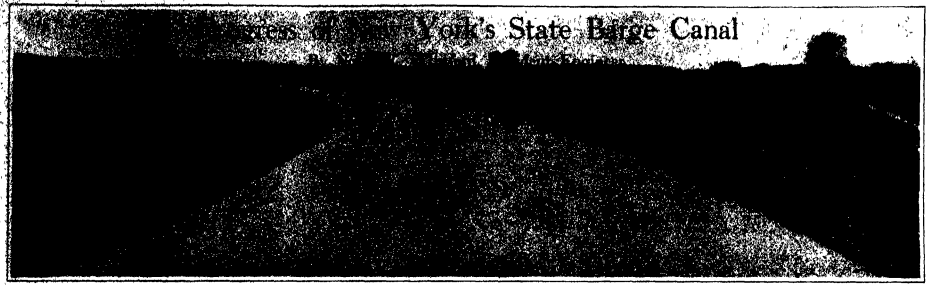
A monkey wrench used as a pipe wrench.

Workshop Notes

How to Weld Cast-Iron.—A good compound for welding cast iron is made as follows: 41½ parts boracic acid, 35 parts common salt, 20 parts ferrocyanide of potassium, 7 parts resin, 3 parts carbonate of sodium. Heat the metal to a light-red heat and apply the mixture over the part that is to be welded. Then heat to a yellow heat, and the welding may be done in the usual manner.—H. D. Chapman.

Novel Method of Removing Broken Ax Handles.—A recent issue of Handy Man's Workshop contained a suggestion on removing a broken handle from an ax head. I think it can be done more conveniently in another way. When I break a handle, I fasten the tool head in a stump or some other place, take my shotgun and put the barrel about 2 or 3 inches from the plug in the ax. The trigger is then pulled, and no matter how hard the handle was fastened, it has to come. There is no danger that the shot will be reflected back to the gunner, even though it strikes the ax head.—H. T. Peterson.

Progress of New York's State Barge Canal



WHENEVER the administrative heads of great enterprises change, the general public renews for a time its interest in the undertakings intrusted to their care, and when these enterprises have a national importance, the interest is intensified. So it is now with the New York State Barge Canal.

At the beginning of the year the incoming State Engineer found construction work on the barge canal improvement about one-third completed and contracts in force covering 96 per cent of the total mileage. He also found that, although most of the work was under contract, many of the contractors had been extremely dilatory, some of them having done very little, notwithstanding the fact that considerable time had elapsed since the award of their contracts. One feature in particular was found to be backward, a feature most essential to the completion of the project, namely, agreements with railway companies whose lines cross the canal, whereby the necessary bridges may be built or changes made.

As the general characteristics of the barge canal—its route, dimensions, number and kind of structures, capacity, cost and the like—have often been told before, they need not now be repeated. Rather it seems preferable to describe briefly some of the special features. By supplementing these descriptions with views of completed sections of the canal and other views of great structures under construction, or interesting bits of detail, a general idea of the undertaking should be conveyed.

At the opening of navigation last spring several of the new locks were so nearly completed that they were put in commission and have been in use during the past season. To maintain navigation on the existing canals, it has been necessary at certain localities to turn traffic into the new channels as soon as they were ready. Such a case has occurred at Oswego, where the canal enters Lake Ontario, and the lock at this junction is, perhaps, the most interesting of any along the whole line, for it is the first siphon lock to be built in this country and also the largest lock to which the siphon principle has ever been applied.

All of the locks on the canal are filled and emptied through culverts in the side walls, these culverts communicating with the lock chamber by means of lateral openings, termed ports. In all of the locks except the one at Oswego the flow through the culverts is regulated by gates, sliding vertically. In this lock, however, the culvert is curved and forms a neck above the top of the wall. To start the flow in this neck it is only necessary to exhaust the air; to stop the water needs but the readmission of air—a simple application of the well-known siphon principle. The interesting part in the device for creating a vacuum. This is a tank built in the wall and communicating by pipes with the upper and lower pools and by an air pipe with the top of the siphon. By filling this tank with water, then closing the upper pipes and opening the lower one, there is produced in the tank the effect of a body of suspended water tending to escape into the lower pool, thus creating the vacuum necessary for operation. The opening of a valve admits air from the siphon to fill this vacuum, and this exhaustion of the air starts the flow of water through the culvert. At a certain stage the rushing water carries the remaining air along with itself and reverses the action of the tank, drawing back the air and reforming the vacuum, ready for the next operation.

The pipe for filling the vacuum tank is 12 inches in diameter, while the outlet measures 20 inches and the air pipe 4 inches. It readily appears, therefore, that all of these valves may be manipulated easily by hand, especially since the regulation of the 4-inch valves is all that is required, unless the leakage of air necessitates the refilling of the tank. This simplicity and economy of operation and of maintenance and the absence of steel work under water to deteriorate by rusting, together with a less cost for construction at this particular location at least, are the features that recommended this type of lock. Its use during the past season has not been disappointing. Two siphon locks are now being designed for the recently authorized addition to the barge canal system—the Cayuga and Seneca canal. The type appeared first in 1896 on a canal in Northern Germany, and since then others have been built at a few places in Germany, but it has characteristics that doubtless will commend it to an increasing use.



A movable dam of the bridge type

There is another novel type of structure that has recently been built on the canal, having been originated in its design, and this also employs the siphon principle. It happens that at certain places there are at times considerable quantities of surplus water that must be disposed of rapidly and yet the surface must not be lowered below a given point. To do this without the use of regulating gates and the accompanying cost of attendance, it is necessary to have some automatic device usually a simple spillway with its crest at the required surface elevation. But cases have arisen on the canal at certain points where there was not room to place a spillway of sufficient length to pass the surplus. Hence the new type—designated a "siphon spillway." It consists of a concrete wall in which are left openings in the form of siphons. The intake is several feet below the surface of the body of water that is to be regulated, while the elevation of the outlet is governed by the depth of the stream into which the surplus is spilled and the bottom of the neck reaches to the elevation at which the water surface must be maintained. As the neck is flattened to the form of a broad, low rectangle with its top at the elevation to which the water may rise before discharge is to begin, the siphon is full when this point is reached, the air having been driven out by the water, and the siphon action becomes automatic. Air vents pierce the upper side of the wall at low water surface and thus the stoppage of the flow is also automatic. A short spillway or drift gap, to carry off floating debris completes the structure. Two of these have been built and successfully operated.

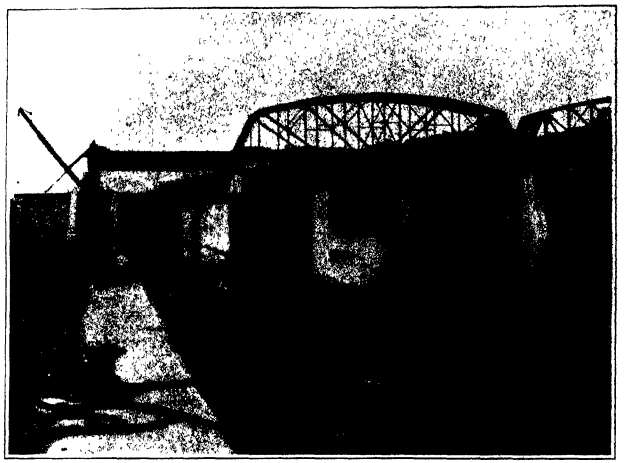
There are certain structures that have been in course of building on the lower Mohawk River for some two years but not until recently have the outlines of their peculiar features become manifest to others than those immediately concerned. These structures are the locks and dams that are located at eight places between Schenectady and Little Falls. The peculiar features are embodied in the dams, for they are movable dams of the bridge type—the first to be built in this country. In constructing them it was necessary first to build abutments and piers, the same as for an ordinary bridge, and also to place a broad concrete sill in the bed of the river extending between abutment and pier. After these operations, a bridge superstructure was thrown across and then the distinguishing features were added—fabricated steel beams suspended in pairs 15 feet apart and reaching from the bridge to the concrete sill. Upon these frames were then placed gates, of heavy steel plate fitted with rollers for sliding on the uprights.

For convenience in regulating the stream the gates are divided horizontally in two tiers. When they are closed and the structure is in operation as a dam, the bottoms of the lower gates will rest on the concrete sill and the tops of the upper series will form the crest of the dam to govern the elevation of the water surface at ordinary stages. Whenever it is desired to permit the escape of more water than will spill over the crest the gates are partially raised, one or all, and the water passes through the aperture thus provided. In time of extreme flood or during the winter season both gates and frames may be entirely removed from the stream, leaving an unobstructed channel. To accomplish this the frames are attached to the bridge by a hinge-like joint, so that they may be swung up under the bridge floor to a horizontal position, carrying the gates with them. Steam winches, moving on tracks on the bridge floor, wind or unwind chain cables, to perform all of the work of operation.

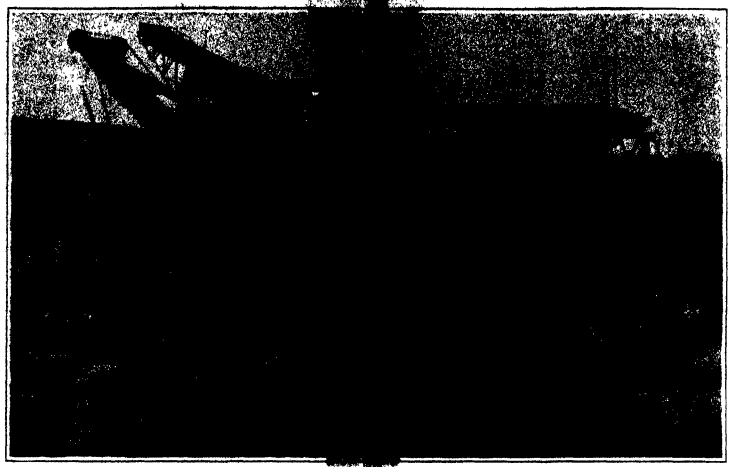
A spectacular feature attending the building of the Barge Canal is a change in the map of the State that will add to its lakes two bodies of water of considerable size. These will impound a needed water supply, and are known at present on the plans as Delta and Hinckley reservoirs.

A profile of the canal across the State shows a continuous descent from Lake Erie to the confluence of Seneca and Oneida rivers, then a rise to the con-

(Continued on page 286)



Typical lock and bridgework.



Tipple incline, used with [illegible] to remove excavated material.



Guard-gate masonry at head of cut into Mohawk.



Shore delivery attachment to ladder dredge.



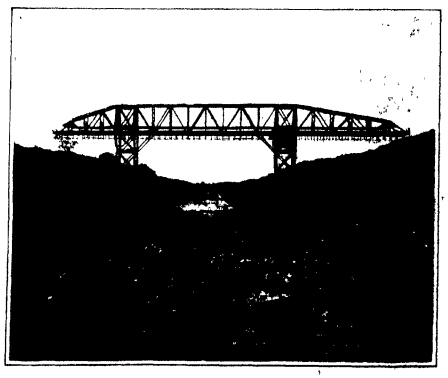
A cantilever excavator.



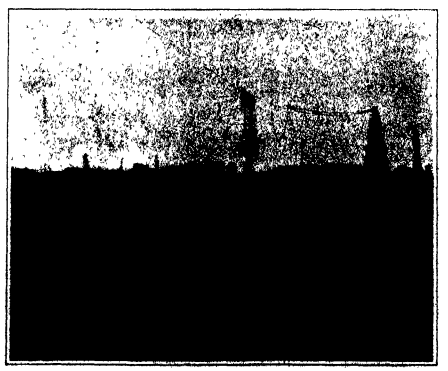
Dam at Delta-crest 100 feet above foundation.



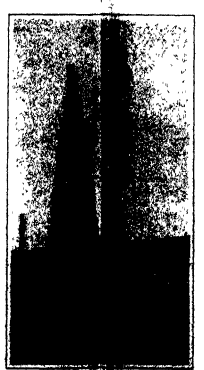
The siphon lock at Oswego.



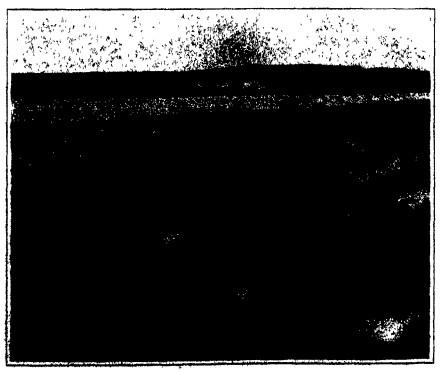
Bridge conveyor operating a 12 cubic yard clamshell bucket.



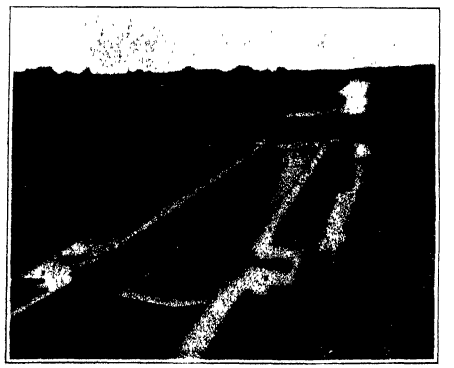
Cableway carrying concrete for building lock chamber wall.



A [illegible]



Crescent dam. (Note rock cut to Hudson in background.)



Lock, near Fort Edward, approaching completion.

THE NEW YORK [illegible] BARGE CANAL

Abstracts from Current Periodicals

Phases of Science as Other Editors See Them

Sir William Ramsay's British Association Address

THE presidential address delivered by Sir William Ramsay before the meeting of the British Association for the Advancement of Science at Portsmouth was a novelty in its distinguished position, for it was discursive. In the opinion of the *London Lancet*, "Sir William Ramsay delivered an address which was generally retrospective, seeking to picture the present position of civilized nations politically, scientifically, socially, educationally, industrially, imperially, in contrast with periods of the past."

The *Lancet* regards as the most remarkable passages in his address those in which he referred to the position of the elements of radium and the wonderful manifestations of its energy. "From its physical and chemical properties radium is an undoubted element, but, as Sir William Ramsay observed, it is a very curious one, for it is unstable, and hitherto stability has been believed to be the essential characteristic of an element. Radium, however, disintegrates—changes, that is to say, into other bodies, and at a constant rate. If one gramme is kept for 1,760 years only half a gramme will be left at the end of that time, half of it will have given off other products. It yields a condensable gas—radium emanation—and besides evolves helium. Helium seems to be a veritable element, and radium emanation has been shown to be incapable of chemical union, but it has been liquefied and solidified in the laboratory of University College, London, and its spectrum has been measured and its density determined. The emanation has been called niton to recall its connection with its congeners, argon neon, krypton, xenon helium and its phosphorescent properties. The atomic weight of niton is 222·4 and that of helium 4. The sum 226·4 is the atomic weight of the parent radium. But the descent does not stop there. Niton in its turn gives radium A and helium, radium A rapidly gives another solid substance, radium B, helium again accompanying the change. Soon a half of B gives place to radium C, but in this case no helium is evolved, only atoms of electricity to which the name "electrons" has been given by Dr Johnstone Stoney. Radium C has a short life, for it changes into radium C', parting with helium atoms. In two and a half minutes, however, radium C' is half gone, parting once again with electrons and forming radium D, which is longer lived, its disappearance eventuating in radium E with apparently no discharge of electrons or helium. Radium E changes spontaneously into radium F, which is the substance to which Madame Curie gave the name 'polonium.' In 140 days, however, polonium in its turn is half changed into an unknown metal, supposed to be possibly lead. Then apparently a check to the rapid descent takes place, for lead within present human limitations, at any rate, is stable.

"But there is no reason why even the stable elements should not decompose when subjected to enormous strains. The virtue of the energy of radium consists, as Sir William Ramsay pointed out, in the small weight in which it is contained, energy here is in an enormously concentrated form. It is disappointing to be told, therefore, that the supply is a very limited one, and that it can safely be affirmed that the production will never surpass half an ounce in any year. The small quantities, however, which have been so far produced have afforded sufficient energy to induce the degradation of elements hitherto regarded as stable. The action of niton or radium emanation on salts of copper appears to show that the metal copper can be converted partially into lithium, and similar experiments indicate that thorium, zirconium titanium, and silicon are degraded into carbon, for solutions of compounds of these, mixed with niton, invariably generate carbon dioxide, while cerium, silver, mercury and some other metals give none. This is all a very wonderful story, and we may well ponder over the possibilities for the human race to which these discoveries are leading. Sir William Ramsay suggests that if elements are capable of disintegration, the world will have at its disposal a hitherto unsuspected source of energy. If radium were to evolve its stored up energy at the same rate that gun-cotton does, we should have an undreamt-of explosive, could we control the rate, we should have a useful and potent source of energy provided always that a supply of radium were forthcoming. If, however, the elements which we have been used to consider as permanent are capable of changing with evolution of energy, if some form of catalyzer could be discovered which would usefully increase their almost inconceivably slow rate of change, then it is not too much to say that the whole future of our race would be altered;' that is how Sir William Ramsay pithily sums up the position. A fuller account of his address will be found in this week's SUPPLEMENT.

Use of Cement Gun by the Government

THE "cement gun," a device for putting concrete in place by compressed air, is being used by the Quartermaster's Department, United States Army, in the Hawaiian Islands, and is proving of value in the construction of the ordnance shop at Fort Ruger. The apparatus was originally provided with a nozzle that became worn and clogged easily. These difficulties were overcome when Capt. Edwards, quartermaster, invented a rubber lined nozzle that gave complete satisfaction. The following description of the device as used in Hawaii is furnished by Capt. A. B. Putnam, Corps of Engineers:

The cement gun is manufactured by a New York company, and consists of an air compressor, a 4-cylinder marine gasoline engine of 20 horse-power, a 1 inch wire-wound rubber hose with walls three-eighths inch thick for delivering dry sand and cement mixed, an ordinary garden hose for delivering water to the nozzle of the gun, and the gun or nozzle itself.

The nozzles originally furnished with the machine were not rubber lined and soon became abraded, so as to render them worthless. The nozzle used by Capt. Edwards, quartermaster, is lined with rubber (about three-sixteenths inch), so that no mortar sticks within. Furthermore, the rubber lining does not appear to become worn under use except very slowly.

A mixture (1 to 2½) of cement and fine sand is delivered to the nozzle at 30 pounds pressure, and just before being discharged is met by a circular spray of water at 30 pounds pressure within the nozzle, so that the wet mortar is projected on the surface to be covered. The water supply is regulated at the nozzle to obtain the correct consistency.

Triangular mesh is secured by staples to the studding of the structure, and is backed up by either heavy paper or wood placed so that the mesh will be in the center of a mass of stucco 1¼ inches in thickness when the spraying is completed. In dwelling houses the stucco is placed on the studding inside as well as outside, but is made only about three-fourths inch thick inside. Smoothing is done by shooting a fine light spray of wet mortar. No finishing is done with the trowel. The finished surface inside is to be painted. The resulting stucco is very hard and makes a fair appearance, though it is necessarily rough. So far, provided the mesh is placed so that edges overlap, I have observed no cracking. It should be noted that this stucco is merely a thin wall of plaster, and bears no strain except that due to its own weight.

When stucco is placed inside and outside, the paper backing (10 pounds per 100 square feet) is left in the wall. When only on outside is placed, the wood or paper backing is removed when the stucco has hardened.

At this date of writing one gun is placing 90 square yards, 1¼ inches thick, per working day. The cost at present, including cost of studding and backing in place, is $1.13 per square yard.

The hose now in use is stronger and heavier than the one supplied with the outfit, and the nozzle is different, being about 12 inches long, as against about 4 inches as supplied, and being rubber lined throughout, so that the mixture never touches metal. There has been but little work done here as yet, so that cost data are not complete, and it has only been since Capt. Edwards applied a new nozzle that the gun worked well.

Tests are to be made by the Isthmian Canal Commission to determine the value of cement mortar, applied to iron plates by the "cement gun," as a preservative of iron at Panama. Twelve plates, 63.8 by 14 inches, have been coated with a 1 to 3 mortar of cement and sand, after they were cleaned to gray metal by the sand-blast process. Six of these have been covered with a ½-inch coating, and the remaining six with a 1-inch coat on one side, and a 1½-inch coat on the other. Three plates of each kind have been sent to Balboa, and three to Cristobal, where they will be kept immersed in salt water to test the mortar method of preventing corrosion. Two plates of each kind will be taken from the salt-water bath at the end of three months, and one-half of the coating will be removed to determine the condition of the metal. The duration of the test for the balance of the plates will be determined later.

Aviation in Japan

IN the *Deutsche Zeitschrift für Luftschiffahrt* Dr. Demcker reviews the history of aviation in Japan. Although the art of making kites has been cultivated in that country from time immemorial, and the man-lifting kite—the precursor of the modern aeroplane—was, according to tradition, utilized by a banished daimio to send a message to his vassals in the year 1156, Japan has been slow in taking a share in the great recent development of aviation, as well as of other branches of aeronautics.

Two years ago, however, the Japanese government sent two army officers to Europe to study aviation, viz., Capt. Hino to Germany, and Capt. Tokugawa to France. These officers, besides making themselves proficient in the art of flying, purchased on behalf of their government a number of aeroplanes of various makes—Blériot, Wright, Grade, Farman—and have now returned to Japan, where they are giving instruction to a number of other officers. For the purpose of these lessons the government has established a large aviation field about two hours' journey by railway from Tokyo.

The government has also organized an official society for the study of aviation, its members all being government employees, including military and naval officers and professors in the imperial university. A grant of $375,000 has recently been voted to this organization.

The Japanese are not entirely dependent upon foreigners for their flying-machines. Capt. Hino, Dr. Narahara, Capt Isobe of the navy, Messrs. Morita and Tsutsuki, and Baron Iga have devised various forms of aeroplane.

Each of the important newspapers of Tokyo now has a department devoted to aeronautics. The *Hochi Shimbun*, the leading paper of the city, has engaged the services of Messrs. Takata and Inouye as "aviation editors," and the *Asahi Shimbun* has a similar functionary in the person of Mr. Usui. The semi-official journal *Kokumin* has offered a prize of $5,000 for a flight over the Bay of Tokyo.

"Stalloy"—An Iron Alloy of Peculiar Electrical and Magnetic Properties

PARTICULAR attention has been given to "Stalloy" by many investigators on account of the claims made by its inventor (Hatfield) with regard to its magnetic properties. A paper on this subject, embodying the results of a research carried on by H. R. Hamley and A. L. Rossiter, appears in a recent issue of the Proceedings of the Royal Society of Victoria. The principal facts and conclusions given by the authors are very briefly summarised below:

"The special feature of 'Stalloy' is its high specific electric resistance and high permeability. The specific resistance being about four times that of the best transformer iron, the eddy-current loss for a given thickness of sheet would be greatly reduced, so that lamination need not be carried out to anything like the extent necessary with ordinary iron, and the question of insulation of lamine becomes less troublesome. It is more expensive than ordinary iron, but the increased expense is compensated by a reduction in size of the transformers, etc., constructed of it, an increase in output, and greatly improved efficiency.

"The special chemical feature of 'Stalloy' is that it contains about 3.4 per cent silicon. The value of this alloy is emphasized in a paper by Epstein, where several tests of its properties are given.

"Several investigations have been made by other experimenters by direct current methods, which agree fairly well together.

"The object of the research was to investigate the magnetic properties of 'Stalloy,' not only with direct current, but also with alternating currents of varying frequencies.

"Summing up generally, it may be said that the chief results to be noticed are that—

"(1) 'Stalloy' cannot be used to advantage in the unannealed condition.

"(2) In the annealed state the results obtained fully bear out the claims made by the makers, the permeability being very high and the losses small, particularly the eddy-current loss.

"(3) The results slightly differ from those of other experimenters, the permeability being generally a little lower in our results than in theirs.

"(4) 'Stalloy' behaves very much like ordinary iron under varying frequencies.

"(5) The constancy of the value of the hysteresis loss for different frequencies is remarkable."

The Inventor's Department

Simple Patent Law; Patent Office News; Inventions New and Interesting

Oddities in Inventions

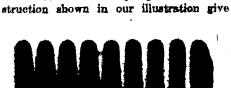
...vel Milk Bottle.—When unskimmed ... delivered to the consumers in the ... type of bottle, the cream forms a ... floating on the milk. In pouring ... the contents of the bottle they are ...essarily more or less disturbed and ...ingled. To provide a bottle that shall ...e free from this defect is the purpose of ...ecent patents here illustrated. The de...vice is extremely simple, resembling in ...general outline the customary milk bottle, ...from which it differs by having a lateral ...neck formed about the point where the



Milk bottle with a cream tap.

bottle reaches its largest diameter. Through this neck a curved tube of glass, paper or other suitable material is inserted, being free to slide in and out a certain distance, or to rotate about its axis. Both necks are closed with paper lids in the usual way. The operation of the device is so straightforward as to hardly require explanation. When it is desired to draw off the top layer of the cream the curved tube is turned with its inner end directed upward. If cream from a lower layer is required, the tube is turned accordingly. In transit, the tube is pushed in as far as it will go, to protect it against injury.

Tubular Springs.—Everyone is familiar with the fact that for a given weight a tubular rod has much greater rigidity than a solid bar, and the use of such tubular members in bicycles, automobiles and airships is a matter of common knowledge. No one, however, seems to have thought, until quite recently, of employing tubes in the construction of springs. A series of experiments carried out at the laboratory of Arts and Crafts (France) has shown that tubular springs of the construction shown in our illustration give



Tubular coil spring.

every satisfaction and possess many advantages, as is pointed out in "La France Automobile et Aerienne." As regards weight in particular, the economy gained varies somewhat according to the dimensions, ranging from about 40 to 60 per cent. But this is not by any means the only advantage. The smaller mass of the spring implies less inertia, with the result that the spring obeys more promptly the impulses which it receives. This is of importance where the spring is required to take up sudden jerks or rapid oscillations. Another effect of the small inertia of the spring is that an impulse communicated to one end of it is very rapidly propagated along its whole length, whereas in the case of a massive spring it is apt to be taken up by the first two coils alone, which are thus placed under severe strain and may be ruptured. Still another advantage is that, in view of the slight thickness of the material, it can be more thoroughly tempered. Among the applications which suggest themselves for the new tubular spring, the first that occurs to one's mind is its use for the alighting members of an aeroplane, in which it will replace the usual rubber bands. So far as weight is concerned, there will be a slight advantage in favor of the tubular spring; as regards working efficiency and durability, the tubular spring is far ahead of the rubber band. The theory of the tubular spring follows along the same lines as that of the tubular rod. As is well known, it is the outer fibers of a rod which are placed under the greatest strain in bending, while the central fibers are practically unstrained. Thus the tube is obviously the most advantageous form for a member which is to sustain bending stresses, inasmuch as all the peripheral fibers, that do the main work, are present, while the central fibers, which are comparatively useless and merely add ballast, are simply eliminated.

Root Shield for Sewer Pipes.—In their search for moisture the roots of trees are very apt to work their way between the joints of sewer pipes, eventually obstructing the pipes to such an extent that they are completely clogged. Then it is necessary to tear up the ground and cut away the roots, for it is impossible to clear the pipes in any other way. This trouble is due, of course, to the fact that sewer pipes are ordinarily loosely telescoped, which results also in leakage at the joints. To protect the pipes against roots, an inventor has recently devised a guard, consisting of two telescoping shield members, adapted to fit over the joint. The flared end of one of the pipes serves as an abutment for one of the shield sections, while a lead ring serves a similar purpose for the other shield section. The space enclosed by these sections is filled with cement. The two shield members are coupled by means of cross pins, fitted through ears in one member and bearing against lugs in the other. The accompanying drawing shows a guard in section as well as an exterior view. It also shows the effects of the roots on an ordinary sewer pipe.



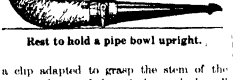
Sewer pipes protected and unprotected from roots.

Refrigerator for Show Cases.—With a view to displaying meats and other provisions in a show case, while keeping them fresh and in a wholesome condition, an inventor has devised a novel form of refrigerator. The accompanying sketch shows a sectional view of a portion of a show case equipped with this system. At the right hand end is the refrigerator proper, consisting of a box provided with a perforated tray or rack, on which a block of ice may be supported. A large port connects this icebox with a compartment below the showcase proper, and here a fan is provided, which serves to drive air through a tube leading to the opposite end of the show case. A constant circulation is had by providing a port to connect the show case with the upper part of the refrigerating box. The arrows show the course of the air. The inventor has found that by this means he may cool the meats in his show case sufficiently to cover them with a coating of frost even in warm weather.



Show case refrigerator.

Rest for Tobacco Pipes.—One of the disadvantages of the ordinary tobacco pipes is the fact that it cannot be laid down without danger of spilling the tobacco ashes, and there is even the possibility of accidentally setting fire to material coming in contact with glowing embers of tobacco. To prevent such conditions a Canadian inventor has designed a clip adapted to grasp the stem of the pipe and provided with legs which will support the bowl of the pipe in an upright position. These legs may be folded against the stem when desired. Instead of employing a clip, he also provides a ferrule or sleeve, equipped with supporting legs, which may be used to connect the stem with the mouth-piece.



Rest to hold a pipe bowl upright.

Combined Salt and Pepper Shaker.—An inventor has recently hit upon a scheme for combining salt and pepper shakers in such a way that one will act as a cover for the other so that each condiment will be kept in an inclosed receptacle, in which no moisture may normally enter. Each receptacle is complete in itself but is connected to the other by a pair of channel-shaped plates which engage flanges on the meeting edges as shown in the cross-sectional view, Fig. 2. Salt or pepper may be shaken out of this combined receptacle on sliding one member upon the other so as to uncover a set of perforations in the face of the compartment from which the desired condiment is to be taken. Figure 1 in our drawing illustrates the shakers moved to such position. After one has helped himself to a quantity of salt or pepper he cannot stand the shaker upon the table with the parts in the position illustrated, for they will not hold their equilibrium. In order that the shaker may stand upright, the two members must be slid back to normal position, so that each will rest on the table.

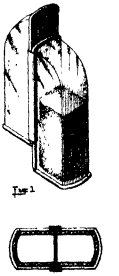


Fig. 1.

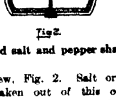


Fig. 2.

Combined salt and pepper shaker.

Machines for Dealing Cards.—Two machines for dealing cards are described in a recent issue of *La Nature*. One of these devices, which is extremely simple is represented in Figures 1, 2 and 3. The pack of cards is placed in a box *B* (Fig 1), which it fits exactly and which is open at one end. A rubber wheel *R* turning on an axis one end of which, *M*, is fluted so that it can easily be turned with the fingers, is brought to bear upon the cards by turning the hinged arm which carries it. When the wheel is turned in one direction, as shown in Figure 2 it expels the top card, when this object has been effected the motion of the wheel is stopped by the impact of the arm *D* upon the pack of cards. The wheel is then rotated in the opposite direction (Fig 3) until the arm *D* strikes the edge of the box. This reverse motion serves to replace any of the upper cards which may have been dislodged slightly in dealing the first card.

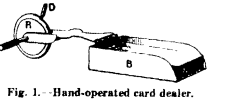


Fig. 1.—Hand-operated card dealer.

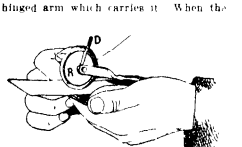


Fig. 2.—Dealing a card.

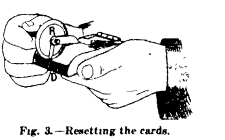


Fig. 3.—Resetting the cards.

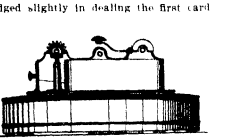


Fig. 4.—Power-operated card dealer.

The operations above described are repeated for each card. With a little practice cards can be dealt very quickly and thrown to a considerable distance. When the front of the pack is pointed slightly upward, the cards turn in the air before falling, but if the direction of

the pack is slightly downward the cards do not turn. Hence the cards can be dealt with their faces up or down, at will. The other machine, the invention of J. Olivier, is automatic and much more elaborate. It is designed especially for the games of bridge and whist, but it can be adapted to other games, using packs of 32 or 52 cards. The machine (Fig. 4) works silently and occupies little space. It is wound up with a key for a certain number of deals, 10 or 12, and a bell gives warning that the machines must be wound up after the next deal. A circular base, resting on rubber feet contains the clock work and supports a rotating platform on which the cards are placed. The platform is turned by a ratchet wheel, a quarter-revolution at a time, and at the end of each motion a rubber cam projects the top card in the direction of the player. The apparatus stops automatically after each deal. It is started by placing the cards in position and pressing a button.

Notes for Inventors

New Vacuum Cleaners.—A vacuum cleaner operated by gas is a new thing for which one great advantage is claimed and that is that it destroys the dirt which finds its way into its interior. Thus it is not necessary to empty the machine. It is not designed to be portable but to be built into the cellar of the house with pipe connections with each floor. It is only necessary to start the engine which is like any small gas engine and very simple to manipulate and then to make the necessary connection with the hose at the point of operation. The dust taken from the floor returns to the machine, where it passes through the flame and is entirely destroyed, the dust passing up the chimney with the exhaust of the engine. In the creation of the vacuum, superheated steam is used. Water is fed into a coil through a needle valve and as it drops from the point of entry, it is turned into steam and finally into superheated steam. The latter is then carried through a curved pipe and forced through a small nozzle into a cone shaped chamber. The action of the steam in rushing into the chamber forms the vacuum. The force of this is said to be sufficient to lift an ordinary building brick and hold it in mid-air. Another of the recent improvements in vacuum cleaners is one which is worked by the water power secured from an ordinary faucet. The device is designed either for portable use or stationary installation. The machine weighs but twenty-two pounds and may be readily carried around the house and placed wherever there is a convenient water outlet. A short tube connects it with the water pipe and a longer one of non-collapsible rubber permits the application of the vacuum at the desired point, remote from the machine. In the handle of the apparatus there is an observation glass for the purpose of watching the work. The machine is successfully operated by a pressure of fifteen pounds which is available in most all water systems. One of the newest features for the convenience of the automobilist is a small vacuum cleaner which is operated by the exhaust from the engine and this is useful not only in the cleaning of the interior of the car but also in removal of the accumulation of dust from the clothes of the passengers after a long ride.

A Pocket Camera.—It is always the big fish that get away and the big game that is encountered by the would-be sportsman when he is without his gun. So the camera worker realizes that he misses many desirable views and snapshots because these opportunities are met with at times when he is minus his camera. Even as compact as these instruments have been made by modern ingenuity it is not convenient to have one's camera always in hand. Hence many excellent views are lost, for it is generally impossible to return to the spot on another occasion and find the same combination of elements which goes to make up a desirable composition. The newest arrival in the camera field is a really and truly vest pocket one, and in such a shape as this the photographer may never be caught unawares. It is not a toy, but designed for serious work. It makes use of either plates or cut films measuring one and three-quarter inches by two and a quarter. These are carried in holders. The instrument is fitted with a fine lens and the pictures made are of such a character that they will stand enlargement up to six and a half inches by eight and a half under all ordinary circumstances; but if the original negative is made under favorable conditions, the enlargement may be greater. While direct prints make very pretty pictures, it is designed that generally enlargements shall be made. For this reason an enlarging machine has been designed for the special purpose of making prints from these negatives. It is so complete that enlargements may be made quite as readily as direct prints. The camera is made in two parts, one carrying the lens and the other the plate. These two are held together by the bellows and a spring hinge. When the parts are collapsed the whole forms a small and compact package which readily slips into the pocket. In fact, the whole outfit complete takes up but little room in the traveling bag or in an emergency could be carried in two pockets.

Young Stokes Takes Out a Patent.—William E. D. Stokes, Jr., of New York city and George W. Davis of Galilee, N. J., assignors to W. E. D. Stokes of New York, have secured a patent, No. 1,001,227, for an aerial for wireless telegraphy and telephony and 1,001,228, for a receiving circuit in the same art. The aerial patent provides two vertical points of support with a wire between them and a series of vertically arranged wires standing in a plane and a switching device by which any of the aerial wires alone can be connected to the receiving circuit. The receiving circuit includes a large copper plate connected to the aerial and embedded in insulating material and supported parallel with the ground by insulating standards.

A Barbed-wire Improvement.—In the manufacture of barb-wire, which is turned out in great quantities, it has been heretofore necessary to make use of a double strand of wire, the two being twisted and the sole use of the extra strand is for the purpose of holding the barb in place. A new machine for the manufacture of this article has been recently perfected by which the barb is pressed in place firmly around a single wire. This saves wire in two directions, namely, in the use of the extra strand and in the cutting of the barbs, the latter being twisted only once, while formerly they were given a double twist. The new machine also has the advantage of increased speed and economy of operation.

Stopping Trains When the Motorman is Killed. Trains of the Interborough lines and those of the Hudson tunnel are being equipped with a safety device which overcomes the possibility of a train running wild when the engineer is killed, injured or otherwise incapacitated. It consists of an electric button which is placed in the handle of the controller and normally, when the operator is at his post, this is in a depressed position, but the instant his hold on the handle is released for any cause whatever an electric circuit is made and the brakes of the train are set.

Erratum

IN our issue of September 16th we published an article entitled "Inventing for the Public." Among the portraits of the government officials who had given their inventions to the public, appeared those of L. W. Page, director of the office of Good Roads, and J. E. W. Tracy. Through an error Mr. Page's name appeared below Mr. Tracy's portrait, and Mr. Tracy's name appeared below Mr. Page's.

RECENTLY PATENTED INVENTIONS.

These columns are open to all patentees. The notices are inserted by special arrangement with the inventors. Terms on application to the Advertising Department of the SCIENTIFIC AMERICAN.

Pertaining to Apparel.

GARMENT FORM.—E. T. PALMENBERG, New York, N. Y., and F. W. KASSUBA, Bayonne, N. J. In this form the arm pieces can be readily removed for fitting purposes, at the same time showing a correct armhole outline. The arm pieces are provided with armhole patterns, of which one has a tongue for engagement with a keeper on the other pattern, to removably connect the arm piece with the shoulder.

SHOE SHINE PROTECTOR.—R. B. LUTHER, Pipestone, Minn. The purpose here is to provide a novel one-piece self-closing protector which will cover the hose adjacent to the shoes while the latter are being cleaned, polished or shined, thus preventing the soiling of the hose. The protector may be used for both low and high shoes.

Of General Interest.

LIFE PRESERVER.—J. STROZEL, New York, N. Y. The main feature of this invention involves the automatic closing of a normally open air inlet valve by the securing of the life belt in position upon the person. The belt is mechanically distended when being strapped on, and this distension draws air into the air chamber, and then automatically closes the air valve, to prevent the escape of the air or the entrance of water.

METAL FRAME FOR GLASS PANES.—A. RUSSE, New York, N. Y. The object of the present invention is to so join the bars that no unfilled openings or protuberances will be presented at the points of intersection in the finished frame, producing an interlocked frame structure of relatively high strength. The invention is an improved metal frame for glass of the character disclosed in Letters Patent No. 942,811 formerly granted to Mr. Russe.

PROCESS OF REFINING AND DESILVERING LEAD.—C. P. HUEY, Omaha, Neb. This improvement relates to refining and desilvering by the crystallization process. The aim is to provide a method for refining and desilverizing lead bullion and impure lead, and whereby the number of crystallizing operations is reduced to a minimum for the proper production of high grade bullion or metal running five hundred to six hundred ounces silver and a market lead.

CAR LOCK.—F. D. STARIN, Whitewater, Wis. The object of this inventor is to provide a device to permit of car lock adjustment to counteract the effects produced by wear. Another object is to provide a device of simple and serviceable construction, inexpensive to manufacture, which is adjustable so as to render the car locks practically noiseless while in operation and also to overcome lost motion occasioned through wear.

NON-REFILLABLE BOTTLE.—S. O. STAUCH, Anaconda, Mont. In this case if any attempt is made to force a liquid down into the bottle the pressure will cause the thin glass strip which holds a valve and ball to break thereby permitting the valve to seat against a valve seat while the ball will roll to the bottom of a conduit, breaking a thin glass partition and will seat itself on another valve seat, which prevents any liquid from the outside from entering the bottle.

ATTACHMENT FOR SUIT CASES AND THE LIKE.—L. SPRY, Clarksburg, W. Va. An object here is to provide a device by means of which that portion of the suit case upon which the lock is situated may be effectually braced, so that when the lock is sprung together it may have a resisting part which prevents the bending of the side of the case and, hence, the failure of the lock to work.

CUTTER FOR WELL CASINGS.—H. MEAD, Coalinga, Cal. Mr. Mead's invention is a cutter for use in removing the casings of oil wells and the like when for any reason the whole string of tubing constituting the casing cannot be pulled. It comprises a supporting head in which is mounted a series of cutter wheels and cutter knives, the number of wheels being equal to the number of the knives in each case, and all the knives and disks being located in the same transverse plane.

SHIP OR VESSEL.—G. E. ELIA, Hotel de Crillon, Place de la Concorde, Paris, France. This invention relates to ships or vessels and is particularly applicable for use in connection with vessels employed in naval warfare, the object being to preserve the stability of the same in the event of their being subjected to the effects of a submarine explosion. This application is a divisional application of one filed formerly by Mr. Elia, the serial number of which is 568,304.

Heating and Lighting.

GAS GENERATOR.—C. F. RUKES, Kansas City, Mo. The hopper in this generator is filled with carbid, and the casing is supplied with water. Whenever the gas in the casing does not exert sufficient pressure to push the diaphragm outwardly, the free end of the switch lever falls between contact [illegible] closes the circuit, thus energizing [illegible] ners. Means provide for shaking the carbid into the water, which generates and opens the circuit. Means are provided for preventing any great amount of carbid from leaving the hopper. The operation is entirely automatic and [illegible] cally constant pressure of gas is maintained.

Household Utilities.

COMBINATION COVER AND DRAINER.—H. GIBSON, Ridgewood, [illegible]. The object in this instance is to provide a new and improved combination cover and drainer, more especially designed for the wash tubs located along the sink or a similar receptacle, the device being arranged to permit its use as a cover for the wash tub or as a drainer for the dishes.

CLOTH FOLDER FOR IRONING.—H. [illegible] RAND and M. M. GRAY, Creecy, Iowa. This device is for use in folding the edges of cloth, strips, or ribbons when being ironed or pressed. The device will operate to fold the edges of the cloth, and also to form a seam for the edge of the iron, enabling the device to be guided in its movement along the strip, cloth, or ribbon.

CLOTHES LINE CLAMP.—W. C. LEA, Chickasha, Okla. The object here is to provide a device which may be easily placed and removed, and which may be locked on the line with or without clothes thereon, and which may be easily and cheaply constructed. When not in use the clamp may be clamped on the line or may be removed if desired. When clamped on the line, the clamp is retained firmly in position and cannot become loose.

Machines and Mechanical Devices.

DISSOLVING VIEW APPARATUS.—H. KRIEGER, New York, N. Y. This invention has reference to optics, and its aim is to provide a dissolving view apparatus, arranged with a single source of light and one lamp casing, thus simplifying the construction of the apparatus and requiring less adjustment and attention on the part of the operator.

DRILLING DEVICE.—R. R. SANDERSON, Orrville, Ohio. An object of this inventor is to provide a device of the walking beam type in which the rapidity of the operations of the drill rod may be considerably increased without sacrificing its effectiveness in any particular, thereby rendering the machine capable of doing more work in a given time than the ordinary drilling device.

ROCK DRILL MAKING AND SHARPENING MACHINE.—M. MCHALE, Phœnix, British Columbia, Canada. This invention provides means for shaping through successive operations the heads of drills as desired to provide means for varying the dies for forming the said heads; provides a sharpening and setting mechanism which may be rapidly and easily varied as to size and design; provides a battery of guiding means to operate in conjunction and unison with the sharpening and setting devices carried by the sharpening mechanism, and provides a machine with an adjustable anvil having a plurality of pockets to hold drills of varying lengths.

VENDING MACHINE.—C. J. FROHL, San Jose, Cal. This machine is for use in dispensing small west account books or the like, which upon the insertion of a specified coin will deliver a single book, and wherein an efficient means is provided for preventing its operation without the insertion of the proper coin, and wherein the coin is utilized to restrain the operation of the machine.

FOLDER FOR SEWING MACHINES.—C. E. MCLIN and J. S. BACHMAN, Rome, Ga. The machine provides a folder suitable for folding cloth in making back bands. The invention comprehends an improved type of mandrel made in two massive parts detachably connected together and so formed that when a piece of suitable material is guided through this mandrel, the material is folded properly to be sewn by the machine and thus made into a back band.

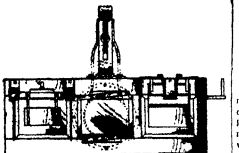
FRICTION CLUTCH.—F. D. ODDEN, Boston, Mass. An object of this invention is to provide a device extremely sensitive in its operation and unaffected by oil, also to provide a plurality of members adapted to be driven one from the other, one of said members having a plurality of spring contact members adapted to be forced into engagement with a clutch face on the other member.

DUST PROOF STEM AND SLEEVE.—D. W. SHEPHERD, Pocatello, Idaho. This improvement refers to open face watches, and its purpose is the provision of a new means for rendering the watch case dust-proof at the stem, to allow convenient adjustment of the stem for winding and setting purposes, and without danger of end shake or breaking.

PROPORTIONING WEIGHING MACHINE.—R. M. CAMPBELL and J. R. TAYLOR, Terrell, Texas. This invention provides a plurality of measuring mechanisms arranged to automatically suspend the delivery of material therefrom; provides an electrically-operated means for dumping one or more of said mechanisms simultaneously; and provides means whereby the number and combination of the weighing apparatuses may be regulated and controlled.

WRITER ATTACHMENT.—J. B. New York, N. Y. This invention re- an attachment whereby the operator in operating the typewriter by the system." A further object is to pro- frame which will divide the various groups into alales by means of suitable and which will further sub-divide the same into tiers by means of stops, whereby the operator's hands are automatic- returned to their position relative to the keys on the typewriter.

MAGIC LANTERN.—ARTURO PAOLI, South Bend, Mich. This invention is an improve- in magic lanterns and a front view of it is shown in the accompanying engraving. The object of the invention is to provide a simple and easily operated mechanism for shifting the picture slides in devices of the character specified, and in such manner that

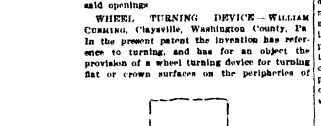


MAGIC LANTERN.

the pictures will merge into one another without any abrupt demarcation between them. As shown in the illustration, the device extends upon both sides of the projector, so that there is space for a slide in front of the projector and space for a slide on each side of the projector. A magazine is provided for use in receiving the used slides and for temporarily storing them.

AIRSHIP.—T. M. CREPAR, Dilworth, Minn. Mr. Crepar's invention pertains to airships, and its object is to provide one with a plane the sides of which converge rapidly at its forward end, said sides converging slowly toward the rear, thereby forming an elongated tail, making the plane substantially fish shape. Another of the objects is to provide two planes, one disposed above the other, there being several openings in each of the planes, and a series of vanes being disposed in each of the said openings.

WHEEL TURNING DEVICE.—WILLIAM CUMMING, Clayville, Washington County, Pa. In the present patent the invention has reference to turning, and has for an object the provision of a wheel turning device for turning flat or crown surfaces on the peripheries of



WHEEL TURNING DEVICE.

wheels too large to be mounted on a lathe. For the purpose mentioned use is made of a bed provided with a straight track and a curved track, a tool carriage mounted to operate on the tracks, and means for operating the carriage over either of the tracks. The illustration gives a plan view with parts broken away to disclose the carriages operating over the curved track.

MOTOR CONTROL APPARATUS.—D. WALD, O. C. BRITSCH and M. TAUBMAN, New York, N. Y. This apparatus may be used in connection with any suitable mechanism, but is especially adapted to be applied to a power sewing machine. The motor control will simultaneously throw the switch with the movement of the control arm, so as to prevent the sparking on the resistance contacts, thus increasing the life of the latter.

SWEEPING MACHINE.—L. B. HOOKER, San Francisco, Cal. The aim in this case is to provide a machine having means by which the rotary brush may be adjusted to any one of a plurality of positions relatively to the frame, with means by which the driving mechanism, supported by the frame, may be quickly adjusted for operating the rotary brush after it has been adjusted.

ELEVATOR.—F. SCHWARM, Berne, Ind. The elevator has a counter weight, the cage or elevator platform being provided with a windlass adapted to wind a heavy balance chain secured to the counter weight so that the excess weight of the chain may be shifted from the cage or elevator to the counter weight and back again as may be desired.

STEAM TRAP.—G. KIESLING, Scranton, Pa. This improvement comprehends particularly a trap having a shifting weight of improved construction arranged in connection with a reservoir for the purpose of facilitating the step of raising the reservoir and of preventing its re- from to normal position until all of the water of condensation is discharged, the return of the reservoir then being effected by the reaction of the weight, under control of gravity, to its normal position.

INSTRUMENT FOR USE IN NAVIGATION.—OTH B. SANDERS, Key West, Fla. This invention relates to a new and improved instru-



INSTRUMENT FOR USE IN NAVIGATION

ment for use in navigation, whereby the true course is determined from the compass course in the shortest possible space of time, by mechanically allowing for the deviation and variation. An object of the inventor is to pro-



VERTICAL SECTION OF INSTRUMENT.

vide an instrument with a plurality of relatively adjustable circular graduations whereby the various deviations and variations may be allowed for. The invention is fully illustrated in the accompanying engravings. The large one is a top plan view and the other a vertical section of the line 2—2. It is inexpensive to manufacture, readily accessible, and easily operated.

CHECK CONTROLLED STAMPING MACHINE.—P. LAMBERTI, New York, N. Y. This device on the insertion of the proper amount of change will impress on an article of mail matter a serial number, the hour and date of mailing, the station or box mailed at, and an inscription stating that the required amount of postage has been paid, whereby a great saving in the handling of letters, and the number of clerks necessary to sell stamps, will be accomplished, and further, whereby any pilfering of the postage money or of letters themselves will be immediately detected.

Prime Movers and Their Accessories.

PACKING FOR PISTON RODS.—J. A. BOLCH, New York, N. Y. Among the principal objects in view here are to provide a packing for piston rods universally connectible to preserve the parallel relation of the bearing surface to the piston rod, and to provide an elongated packing for piston rods constructed from metal and arranged to contract evenly throughout its length upon the rod.

GAS TURBINE.—F. KRAUSE, Babylon, N. Y. This invention relates to certain improvements in turbines and more particularly to that type of turbine in which an explosive mixture is ignited in a separate chamber and admitted to the blades of the turbine. One of the important features is the means employed for controlling the explosive mixture and the delivernce of the same to the blades of the turbine.

INTERNAL COMBUSTION GAS-TURBINE ENGINE.—E. ANWELL, Baltimore, Md. This invention provides an engine wherein the explosive mixture is primarily compressed and exploded while so provides an explosion chamber wherein is exploded the compressed charge of explosive mixture while establishing communication between the said chamber and the turbine rotor, provides a reciprocating mechanism for compressing and firing the mixture as distinguished from the turbine mechanism and provides an engine employing in mutual operative relation a reciprocating explosion chamber and a turbine shaft driving rotor.

EXPLOSIVE ENGINE.—W. W. WELLS, Clyde, Ohio. In the present patent the invention is an improvement in multiple-cylinder engines, particularly engines in which the cylinders are arranged in pairs and are co-operative with each other in the introduction of scavenging air preparatory to the admission of the explosive charge.

INTERNAL COMBUSTION ENGINE.—A. M. CLEMENT, New York, N. Y. This invention provides sliding-valves arranged and constructed to avoid leakage of gas due to wear of the sliding parts; provides a simplified construction for valves whereby expansion pressure is relieved therefrom during movement thereof; and provides a valve operating mechanism embodying a single cam and simplified transmission mechanism connected therewith.

ROTARY ENGINE.—HENRY HEYER, New York, N. Y. This invention relates more particularly to an engine comprising a stator casing, a rotor in the casing, a steam chest, a movable steam duct therein adapted to be arranged in different positions to direct the fluid under pressure into the casing in different directions, and vanes carried by the rotor and adapted to receive the fluid at opposite sides according to the position of the steam duct.

TRACTION ENGINE.—D. O. DEWITT, Aberdeen, S. D. The objects here are to provide a traction engine which may be operated with a minimum of power, especially over soft ground; to simplify the construction by cutting parts usually employed in the running gear, to provide facilities for steering and piloting the machine over uneven and soft grounds with freedom, by a single operator, and to dispense with the differential gear used in machines of the class to which the invention belongs.

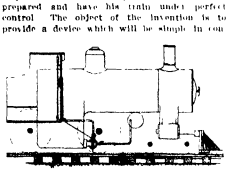
Railways and Their Accessories.

TRACK MOVING MACHINE.—E. L. HAYWARD, Davenport, Iowa. In this patent the invention has reference to improvements in means or apparatus employed in handling steel and ties in track construction. The intention here is to provide means or apparatus for use especially in timber lands, whereby the handling and transportation of track material is facilitated.

METALLIC TIE AND RAIL FASTENING DEVICE.—J. F. ROBINSON, Atlanta, Ga. An object of this inventor is to provide a tie which shall form a resilient bearing surface, thereby absorbing shocks. The tie will prevent the spreading of the rails and the accidents consequent thereto. A spring rail fastening device is provided which holds the rail in fixed position, thereby doing away with the usual method of fastening rails by spikes.

RAILROAD CROSSING.—J. B. DUNLAP, Tulsa, Okla. An object in this instance is to provide a crossing which obviates the usual jars incident to the passage of a train over the crossing. This is accomplished by providing movable track sections which may be so moved as to complete the track in either direction so that the tread of the wheels may move on a continuous bearing surface.

OPEN SWITCH SIGNAL.—THOMAS J. RICE, Office Quartermaster's Dept., U. S. Army, Honolulu, Hawaii. This invention has reference to a means of warning an engineer that he is approaching an open switch rather a quarter of a mile off, so that he may be prepared and have his train under perfect control. The object of the invention is to provide a device which will be simple in con-



OPEN SWITCH SIGNAL.

struction positive in its action, and which will have the fewer parts consistent with accurate working and which at the same time will be strong and durable. The engraving shows the signal attached to the engine and a tripping mechanism located on the track. Means provide for making the signal sounding mechanism inoperative when desired.

CAR WHEEL FLANGE LUBRICATOR.—J. L. FERRIS, Montezuma, Mexico. The invention relates to an automatic car wheel lubricator, and provides a device which will positively supply a lubricant to the flanges of the car wheels when they are rounding curves to prevent friction between the car wheel flanges and the rails, the lubricant being fed in atantaneously and in sufficient quantities

Pertaining to Recreation.

MOTOR CYCLE TANDEM ATTACHMENT.—W. P. SPENCER, San Jose, Cal. The object of the invention is to provide an attachment by means of which the ordinary single passenger motor cycle may be converted into a two passenger vehicle with the seats tandem without any changes in the structure of the vehicle itself. The attachment is simple and inexpensive and easily attached and detached. No change is necessary in the construction of the cycle.

TROLLING HOOK.—J. P. THOMSON, Owen Sound, Ontario, Canada. The invention relates generally to trolling hooks for fishing, and the principal purpose is to provide a hook having the spoon or bait revolubly mounted thereon so that when in the water the spoon or bait will be attractive to the fish, the spoon being revolved as the hook is drawn through the water.

TOY.—M. A. BURRIS, University, Va. In this invention the improvement is in toys, and its object is the provision of a simple, cheaply constructed toy, especially designed to afford amusement, while at the same time developing quickness of observation, and dexterity of hand. A nut catches the game piece when the operator fails to properly place the piece and an opening permits the said piece to be returned readily to the shank.

Pertaining to Vehicles.

WAGON BOX FASTENER.—H. F. BART, Broken Arrow, Okla. The purpose of this improvement is to provide a simple inexpensive and easily operated device for use in holding the parts of the box together without injuring the same, which may be quickly applied or removed. The device consists essentially of a pair of telescoping members or bars each having a clamping jaw at the outer end co-operating with the jaw of the other member and a clamp for holding the members in adjusted position.

AUTOMOBILE AIR PUMP.—C. CLEMENS, New York, N. Y. The invention provides a pumping mechanism operatively attached to the driving axle of an automobile for inflating the tires of the wheels not directly connected with the pumping mechanism; provides means for manually operating the pumping mechanism independent of the wheel and power driving mechanism of the automobile, provides means for uniting the wheel of the automobile with which the pumping mechanism is connected as a fly wheel for the pump when the same is manually operated, and provides means for rigging a drum on an automobile driving wheel to extend about the axle when carried thereby to inflate the tire of the wheel on which it is mounted.

SIGN HOLDING DEVICE.—W. A. RINGS, 1022 Ionia Street, Grand Rapids, Mich. In this instance the invention pertains to devices for holding signs more particularly those that are to be used to display the license number of automobiles. An object is to provide a device by means of which a sign may be held rigidly in position so that there will be no danger of the sign's becoming loose and dropping from the vehicle.

WIND SHIELD.—J. H. SCHAUER, Norwalk, Ohio. This invention refers to shields adapted for use upon motor vehicles, and more particularly to that type of shield which has a transparent section movable to operative or inoperative position. One important feature includes the use of rollers within the hinge and fitting in V shaped grooves for locking the sections of the shield in predetermined relationship.

TAXIMETER CONTROL.—J. D. SULLIVAN, New York, N. Y. In this case the invention refers to a new and improved attachment for taximeters whereby the taximeter may be controlled so that the chauffeur cannot conventiently operate the taximeter without recording the distance traveled when the taximeter is occupied by a passenger.

SPRING WHEEL.—O. H. HINDS, Le Mars, Iowa. This invention provides a novel construction of spring wheel in which the lateral rigidity incident to or characteristic of the ordinary automobile wheel will not be impaired and in which springs may be utilized to secure the desired resiliency of the wheel in a radial direction in a simple and efficient manner.

TIRE.—O. H. HINDS, Le Mars, Iowa. In this patent the invention is an improvement in tires and particularly in the means for excluding dust, dirt and the like from the joint between the flanges from the rim and the tire which is movable radially in said flanges, the present application being a division of an application formerly filed by Mr. Hinds.

SPOKE FOR WIRE WHEELS FOR VEHICLES.—W. P. PECK, Jr., Buffalo, N. Y. The rim of this wheel is divided transversely so that it is formed practically in halves or nearly equal semicular sections one of which is fast on the steering shaft and thus constitutes a hinge and thus adapted to be raised and folded back upon the fixed section so that it will not obstruct the chauffeur in entering and leaving his seat.

VEHICLE WHEEL.—A. BROOKES, Lancaster, Wis. The invention relates to improvements in automobile wheels and particularly to the tire thereof, whereby an increased durable resiliency is obtained. An object is to provide a tire composed of a plurality of resilient members, preferably of a metallic nature, spaced apart and connected together to form a continuous resilient element.

Designs.

DESIGN FOR A GLASS GOBLET OR SIMILAR ARTICLE.—C. O. NORTHWOOD, White Mills, Pa. In this ornamental design of a glass goblet, the article is of the elongated type of bowl and stem, the whole set in a somewhat flat stand. The flowers, leaves and tendrils decorating the glass are of peculiar interest and beauty. Mr. Northwood has another design which is very much broader and shorter than the one described and set upon a very short stem the ornamental feature being at the rim and extending about one-third down the length of the bowl-shaped body.

NOTE.—Copies of any of these patents will be furnished by the SCIENTIFIC AMERICAN for ten cents each. Please state the name of the patentee, title of the invention and date of this paper.

NEW BOOKS, ETC.

THE AEROPLANE By Claude Grahame White and Harry Harper Philadelphia J B Lippincott Company, 1911 317 pp 93 illustrations Price, $3.50

Although the title of this book reads "The Aeroplane Past Present and Future, by Claude Grahame White and Harry Harper, only a few articles are to be credited to Mr Grahame-White or to Mr Harper and why they should figure as authors seems somewhat mysterious As a popular book on aeroplanes, the book is likely to serve a useful purpose, even though there are probably now no less than three or four dozen simply worded volumes on aeroplanes struggling for existence in the book market Much practical information is not conveyed By far the best article in the book is that by H Chippere discussion of the aeroplane in warfare, a sane presentation of the possibilities and limitations of the flying machine for military purposes For popular reading, the book can be commended, but for valuable technical information, the reader will find it far too ephemeral

DIE EXPERIMENTIELLE GRUNDLEGUNG DER ATOMISTIK Von Werner Mecklenburg Jena Gustav Fischer, 1910 140 pp Price, 250 marks

The atomic hypothesis has long possessed a double sphere of usefulness To the chemist it has represented a most convenient picture by means of which to express in simple terms the laws of chemical combination So convenient, indeed, to the chemist has been the language of the atomic theory, and so generally adopted has its use become that when Wald pointed out, some years ago, how all the facts of stoichiometry could be accounted for without recourse to this hypothesis, he found himself speaking to a rather unappreciative audience Wald probably would have passed almost unnoticed but for the authoritative support lent to him by Ostwald in his Lansday lecture and on other occasions There seems to be little doubt that the evidence of chemistry alone would have been insufficient to firmly establish the atomic hypothesis But, on the other hand, this hypothesis has been of supreme interest to the physicist firstly in its relation to the mechanical theory of heat with its off shoot, the kinetic theory of gases, of solutions, and latterly also of suspensions, and secondly, in the development of the electron theory The evidence which has thus accumulated in favor of the atomic hypothesis is now well nigh irresistibly convincing so that even Ostwald, formerly so strongly opposed to the atomic point of view, openly declares himself its adherent, and definitely accepts the atomic constitution of matter as one of the basic starting points of chemical science, in his last edition of his "Outlines of General Chemistry The author of the book under review may be envied for the extremely graceful task which he has undertaken that of laying before the reader a concise and yet essentially complete account of a field of physical science, which has from the first possessed features of remarkable interest, but which especially in late years has brought forth developments having short of spectacular Have we not to day direct optical evidence of particles very little greater in size than the calculated diameters of an ultimate molecule? Have we not, it be said, display all the characteristic properties and phenomena foreseen by the theoretical physicist in his investigations of the nature and behavior of molecules If the determination on theoretical grounds of the molecular dimensions by the work of Clausius, Maxwell, Boltzmann, impresses us as a triumphal feat of human intellect the confirmation of their conclusions by direct experiment comes as a crowning testimony, both to the power of that intellect and to the resources of experimental skill And if the subject is one of remarkable interest, the author has been equally fortunate in his treatment of it In the course of four chapters he has led the reader in simple terms the main experimental facts and theoretic ideas of reasoning upon which the modern structure of the atomic hypothesis is built The first chapter is headed "The Existence of Discrete Particles in Seemingly Homogeneous Solutions" the second deals with

The Dimensions of the Molecules as Determined by the Kinetic Theory of Gases" The third chapter is devoted to that remarkable phenomenon known for some time but almost forgotten by the physicist the Brownian movement which has quite recently proved such a rich mine of information of the highest importance in the final establishment of the atomic theory upon an experimental basis The fourth and last chapter deals with another subject the study of which has proved one of the most fertile fields of modern physical research, and has contributed immensely to the very cornerstone of the atomistic point of view

The author has succeeded in striking a most happy medium between a purely popular presentation on the one hand which for lack of detail would fail to give the reader a true insight into the nature of the very remarkable developments discussed and on the other hand, a highly technical treatise from which only the specialist could derive any advantage The book is most highly recommended to all who take an interest in the chemical and physical phenomena to which it refers, and quite especially to those who, having at least some knowledge of the subject, wish to refresh their memories on familiar points, and to bring their acquaintance with a most fascinating province of physics up to date It is heartily to be wished that translations of this work into English and French may soon appear upon the book market

A few such errors as unavoidably occur in a first edition have been noted in perusing the book and may be listed here for the benefit of the reader On page 22, line six from below, the symbol x has apparently been omitted after the word "Höhe" This might possibly cause some confusion On page 23 it is stated that a table of molecular dimensions, etc., is appended at the end of the book In point of fact, this table appears between pages 64 and 65 On page 106, the word "Gramolekülen" should evidently be Grammolekülen" These trifling errors do not of course, in any way detract from the very high value of the book before us

POWER By Charles E Lucke, Ph D New York The Columbia University Press, 1911 316 pp Price, $2 net

In 1910 Prof Lucke delivered a series of eight lectures on the phases of power These lectures have now been incorporated in book form in a worthy manner The titles of the lectures are the following I The Relation of Mechanical Power and Machinery to Social Conditions, II Means Employed for the Substitution of Power for the Labor of Men, III Essential Elements of Steam Power Systems, IV Principles of Efficiency in Steam Power Systems, V Processes and Mechanism of the Gas Power System VI Adaptation of Fuels for the Power of Internal Combustion Engines VII Water Power Systems and Rental Hydraulic Processes, VIII Social and Economic Consequences of the Substitution of Power for Human Energy Such a subject could be well written with such clearness that a layman of intelligence ought to be able to understand them

A POTTERY PRIMER By W P Jervis New York The O'Gorman Publishing Company 1911 8vo, 188 pp., Illustrated Price, $1

It is not surprising that the art and craft of pottery should appeal strongly to the artistic heart of mind or that its products should have raised up an enthusiastic army of collectors Its history appeals to us on many sides It has associations which bind past and present, foreign and native It builds up common clue into expressions—often very beautiful expressions—of the higher mind It is flower-like in its fragility, in its blending of body and spirit Its symbolism has permeated the literature of the world for countless ages The Potter Primer" is the work for the individual preserment of body and mind—the technology processes and technique of the craft, together with not a little of the grace and ethereal freshness that belong to the art The Illustrations place before us examples of ancient treasures and more modern works and admirably serve the writer's avowed purpose to awaken the reader to a desire for further research In addition to the plates cups and vases which typify succeeding phases of history, we have glimpses of panels lantern, fountains and mantels of distinction This is really a more than usually good book and is a noteworthy addition to Mr Jervies earlier works on ceramics pottery and pottery marks

RADIUMNORMAL MASSE UND DEREN VERWENDUNG BEI RADIOAKTIVEN MESSUNGEN By E Rutherford Leipzig Akademische Verlagsgesellschaft m. b. H. 1911

In the course of the last decade our knowledge of radioactivity has rapidly widened Not only have the types of radioactive substances which emit radiations been carefully studied but much labor has been spent in trying to fathom the nature of the complicated processes which occur in radioactive matter A theory has been proposed which for the time being explains satisfactorily a great number of phenomena That theory, which is called the transformation or disintegration theory was first proposed by Rutherford and Soddy in 1903 and was based upon the supposition that the radioactive atom is unstable and that it decomposes with explosive violence at the same time emitting characteristic radiations As the result of this atomistic explosion a new atom is produced, quite different from the parent in chemical and physical properties These new atoms are also unstable, and give rise to another set of atoms Thus the process may continue for some time In the investigations of this kind standards of some kind are necessary This book of Prof Rutherford's which is no doubt familiar to many English readers in its original English expresses the necessity for a normal mass of radium and its use in radioactive measurements a matter which was discussed at the last radiological congress held in September, 1910, in Brussels

A YEAR IN A COAL-MINE By Joseph Husband Boston Houghton Mifflin Company, 1911 12mo., 171 pp Price, $1 10 net

Ten days after leaving college a young Harvard man became a laborer in a non-union coal mine of the Middle West—starting very literally at the bottom with the aim of learning the business thoroughly. The ordinary work and life of the underground city would alone make good reading at the hands of an educated man with a sympathetic knowledge of nature values but Husband was fortunate enough, or it is our good fortune, if you so prefer, in experience in that one short year all the thrills that strikes, fires, and explosions are capable of furnishing The result is a document of some value as a study of mining conditions, and of popular interest in so far as hazardous moments and adventurous days can make it

UNSOUNDNESS OF MIND. By T. S Clouston M D, LL.D, F R S E. New York E P Dutton & Co, 1911 8vo.; 360 pp., 14 illustrations. Price, $2.50 net.

Popular interest has of late years been quickened toward this important subject Criminals are more and more availing themselves of the plea of insanity in an attempt to escape punishment We still ridicule the weak-minded and subject the inmates of our insane asylums to unnecessary cruelties; but we are slowly learning that a diseased brain is as much a physiological fact as a diseased liver, and that no odium should attach to its victim Dr Clouston handles a most difficult subject in a manner nothing short of masterly The volume answers, or at least discusses illuminatingly, the most absorbing questions Since a man now appears to act irrationally, and an insane subject frequently presents no irrational thoughts or actions to our view, how may we distinguish between a sound and an unsound mind? If, in infancy, we look for the signs of the corresponding nerve cells of the motor centers in the brain shrivel up To what extent have we localized in the brain these various functionings? What proportion of guilt is usually found in crime? Are we all a little affected, as the well-known remark of the old Quakeress would lead us to mistrust or is our universal mind built upon a true foundation? Dr Clouston shows for us eleven orders of brain in their characteristic workings His conclusions are optimistic as his opposing facts well weighed The relation of heredity, of nerve exhaustion, of other causes, to unsoundness of mind and insanity, is made wonderfully clear and, not stopping at a mere presentment of the evil, suggestions *for preventive and curative regimen* are given The hopeless cases are differentiated from the hopeful, ranks from melancholy, the functional difficulties from the organic, and the workings of the brain are bared to the gaze in a way that all can understand The volume embodies the latest theories and discoveries, and clearly conveys knowledge that no parent at least should be without Its suggestions, if followed, would vastly decrease the world's troubles and result in the improvement of the human race

ELEMENTARY CHEMISTRY FOR COAL-MINING STUDENTS By I. T O'Shea New York Longmans, Green & Co., 1911. 8vo., 319 pp; illustrated Price, $1 50 net

As the name indicates this book sets forth such simple chemical principles as bear upon the work the welfare and the safety of coal miners and the value of their product The chapter on the air of coal mines can be adequately dealt with only by a fuller knowledge of chemical action and combination This touches the problem on its life-saving and property conserving sides On the purely economical side of the question, coal itself must be regarded as a combination of carbon, hydrogen, nitrogen, oxygen etc., and the proportions of these determine its value for particular purposes Its constituent parts are also taking a part of growing importance, in that it determines the value of a coal in its application to special uses Colliery explosions are made the subject of careful study The book should be cordially received by all who are interested in what it has to offer

ABROAD WITH THE FLETCHERS. By Jane Felton Sampson Boston I. C Page & Company, 1911 8vo., 368 pp.; Illustrated Price, $1 60 net.

"Abroad" has reference to the stereotyped circuit from Naples to Rome, Florence, Venice and Milan; through Switzerland and Western Germany with a dash up into the Netherlands and a descent through Belgium to Paris, thence to London, to Scotland, and back to Liverpool to take the homeward steamer "The Fletchers" are a quaint old couple of the usual type, through whose eyes all the old familiar sights are seen from a new angle The savings of Thomas Jeremiah Fletcher form no small part of the recital, which, showing a 'prentice hand, still atones by a certain freshness and spontaneity for any technical shortcomings The illustrations are from photographs by the author, and are very clear and good

HALF HOURS WITH THE SUMMER STARS. By Mary Proctor. Chicago: A. C. McClurg & Co., 1911. 232 pp.; Illustrated

In this little book Miss Proctor has given just the kind of information which the average astronomically uninformed man desires about the stars Not only does she give the mythological significance of the more important constellations of stars, but the result of most modern scientific discovery.

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(12541) J M M asks The Nebular Hypothesis assumes the cooling of hot bodies in space I have been unable to find any explanation consistent with the present theories of heat and of matter, as to what is, and as to how such cooling takes place, and what becomes of the heat lost by the cooling body. Obviously, it must either exist in space or be destroyed We cannot assume its destruction. The assumption that it exists in space in the form of heat waves in the ether leads to difficulties If this be so, only an infinitesimal portion of the heat lost would ever be picked up by any other body, and the total amount of energy in the material universe is and always has been constantly decreasing—hardly a safe assumption Nearly everybody knows how greatly the narrow and imperfect vacuum of a thermos bottle retards the loss of heat. The absolute and limitless vacuum of space must be far more efficient I shall be greatly obliged if you will clear up my difficulty, or still refer me to some discussion of the questions involved. A. No one can answer the question you ask as to the final disposition of the heat radiated into space constantly by the sun and all the heavenly bodies It is as unanswerable as that other conundrum, "What becomes of all the pins?" The law of the Conservation of Energy requires us to believe that it is received by other bodies which are colder and is absorbed by them for a time, to be radiated again, and so pursue a ceaseless round of radiation. Your statement as to the thermos bottle is not quite correct Radiation is not impeded by a vacuum. The little whirling radiometer shows that. A century ago or more, Rumford placed a thermometer in a Torricellian vacuum, such as is found in the barometer, and showed that it was immediately affected by external heat, by immersing the vacuum bulb in hot water. The vacuum in the thermos bottle prevents conduction and convection, the polished surfaces prevent radiation as far as it can be prevented. The thermos bottle thus becomes the best insulator for heat waves which we have. It is a modified Dewar bulb, such as is used for liquid air, made more durable than the usual Dewar bulb. You will find in our SUPPLEMENT 1883, price ten cents, a valuable article upon the "Heat Insulating Efficiency of the Exhausted Bulb."

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Artificial Life

(Concluded from page 372)

causes or conditions of development and growth. For the egg cell of many plants or animals is in a resting stage and can begin to develop, or, it can resume its activities, only after fertilization. Quite apart then from the relation to heredity, the process of fertilization must be somehow intimately related to the process of growth, the process of cell-division and those other processes that constitute the life of the organism. To produce artificial parthenogenesis is therefore to find the physico-chemical equivalent of a fundamental vital process.

For twenty years experimenters were able to make various physical and chemical agents do the work of the living sperm in causing the egg to begin its development, but the substitute was not quite complete, for the development in every case proceeded only a short way. A fertilized egg begins its development by a division of the nucleus into two halves, which form the centers of two cells. Each of these divides again, making four, these divide into two again, and so on, until (in very many species of animals) there is formed a hollow sphere of one layer of cells (Figs. 4 to 7). At this stage all the cells are practically alike. From this point on there appear various changes and differentiations in development. Most of the earlier experiments in artificial parthenogenesis did not carry the development of the young organism much beyond this stage. In recent years it has been possible to obtain artificially parthenogenetic individuals of sea-urchins and other organisms developed to a much farther stage, in some cases even up to the appearance of the adult form.

The first record of artificial parthenogenesis is that of the Russian zoologist, Tichomiroff, who in 1886 made the unfertilized eggs of silk worms develop by brushing them gently, or by placing them for a short time in concentrated sulphuric acid. During the following year Dewitz tried to induce development in unfertilized frog's eggs by treating them with corrosive sublimate, and reported successful results. But his experiments were repeated by Wilhelm Roux, who found that what Dewitz took to be early segmentation stages in the unfertilized frog-eggs were merely wrinklings on the surfaces. However, Richard and Oscar Hertwig observed the beginnings of segmentation under the influence of various poisons. In 1898, Kulagin experimenting with the unfertilized eggs of frogs and of fishes, obtained the beginnings of segmentation through the use of diphtheria antitoxin. These results have not been repeated, and their significance is not clear. Prof. Morgan used a variety of salts in the attempt to induce artificial parthenogenesis, and obtained a succession of nuclear divisions, but no true segmentation.

The most elaborate and fundamental experiments in artificial parthenogenesis are those by Prof. Jacques Loeb, begun in 1899. After familiarizing himself with the behavior of sea-urchin eggs under different conditions, and in relation to the sperms of several other marine animals, he began a series of experiments that have served as the basis for practically all subsequent work in this field. His first experiment consisted in raising the osmotic pressure of the water containing unfertilized eggs, by the addition of a quantity of common salt solution, and then returning the eggs to normal sea water. Although the results were different with different species, he obtained positive results with all of them. Yet the development of the eggs was not exactly the same as in the case of eggs normally fertilized.

One difference was that the fertilized eggs always formed a thin but distinct membrane before developing; the fertilized eggs developed much more rapidly than the parthenogenetic eggs; the fertilized eggs developed in about 100 per cent of the cases, whereas with the experimental eggs he obtained at first from 1 to 2 per cent. The larva of fertilized eggs had a smooth outline and swam near the surface of the water; the larva from the parthenogenetic eggs had a ragged outline—owing to the absence of a membrane—and clung to the bottom of the tanks (Fig. 3b.) From these differences it was included that the osmotic action of a hyper-tonic solution suffices to initiate not all of the effects of fertilization, but only some.

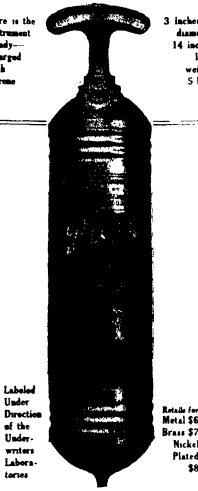
But later Loeb was able to induce the formation of a membrane in unfertilized eggs by the use of certain organic acids (monobasic acids of the fatty series, such as acetic, butyric etc.) Now the treatment of these eggs with the hyper-tonic salt solution after the formation of the membrane resulted in the normal development of the sea urchin eggs up to the so-called "Pluteus" stage (Fig. 2.) In these the rate of development and the surface-seeking habit were also as in the fertilized eggs.

When others tried to check this work by repeating the experiments in other laboratories, the results were widely divergent. Prof. Loeb himself then showed that these differences were due to the different chemical condition of the water at the various biological stations: the degree of alkalinity of the water is an essential factor. While in his earlier experiments he never had more than one egg in five develop, he was able to get 100 per cent after finding the relation of the alkalinity to the beginning of development. By means of an alkaline bath he induced the formation of membranes in the unfertilized eggs of a marine worm (*Polynoe*), and these were then induced to develop into normal larvæ, by means of osmotically active solutions; and by varying the concentration of the salt in the sea water, the rate of development could be regulated. By changing the alkalinity of the water, the sperms of star fish were so modified that they fertilized the eggs of the sea-urchin.

Step by step the results of these and other experiments were analyzed, and Loeb concluded that the first effect of fertilization, or the first essential for the resumption of activity on the part of the egg, is some liquefaction or hydrolysis (or both) of certain substances in the egg. But how this change was brought about was unknown. Hans Winkler thought that the sperm brings into the egg an enzyme or catalyzer. He reported to have caused unfertilized eggs to develop by treating them with an extract from sperms. Dr. Giles, of the College of Physicians and Surgeons (Columbia University) repeated Winkler's experiments and obtained only negative results. Using the unfertilized eggs of fishes, Cremer also had only negative results. Loeb showed that it was neither the addition of a positive catalyzer nor the removal of a negative catalyzer that started the segmentation. After the activity of the resting egg is renewed by either a sperm cell or by some one of the physico-chemical agents—which Morgan compared to a *stimulus*—there is needed something to make the nucleus grow and divide, this second factor Loeb considered to be something that will start the process of oxidation in a certain direction, since it is only through oxidation that nuclear matter could be made out of the reserve nutrients in the egg cell.

Yves Delage obtained results parallel to those of Loeb producing a membrane on unfertilized sea urchin eggs by means of acids and the subsequent liquefaction by means of an alkali. Later he was able to combine the action of the two factors in one solution by using tannate of ammonia. With this combination he was able to secure development without the presence of oxygen; his methods for eliminating oxygen, have, however, been criticized. He obtained also similar results with the eggs of starfish.

As a result of some of Loeb's work, the action of the chemicals used in these various experiments was compared to the action of ions, or of electric charges. To test the validity of the assumption that alkalies acted because of the negative ions (—OH) produced when they were dissolved in water, and that acids acted because of the positive ions (+H), Delage arranged an apparatus in which charges of electricity could be sent through the unfertilized eggs. He obtained a varying number of developing eggs as a result of sending first a positive and then a negative charge through the preparation. The following year, however, on repeating his



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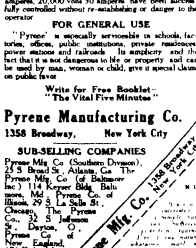
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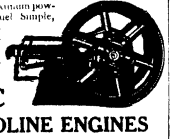
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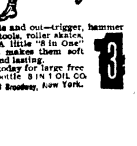
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experiments with improved apparatus, he concluded that neither electric charges nor electric currents have a direct effect in producing artificial parthenogenesis. The development of the unfertilized eggs in his first series of experiments he attributed to the action of acids and alkalies produced in the sea water under the influence of the electric charges From these results, and from other experiments in which he induced unfertilized eggs to develop through the use of various neutral chemicals — organic and inorganic — he concluded that the artificial parthenogenesis was always due to some specific chemical action upon some catalyzer, and a physical action upon the surface tension Delage succeeded for the first time in raising artificially parthenogenetic eggs up to the adult form Two of the individuals that had developed almost to maturity were both males

Parthenogenetic development was produced artificially by several investigators both in this country and in Europe, in the eggs of various species of marine worms, echinoderms and molluscs For example, Prof Lefevre of the University of Missouri induced normal development of the eggs of the worm *Thalassema mellita* by placing them for a few minutes in dilute acids

Six years ago Prof Michael F Guyer of the University of Cincinnati caused the unfertilized eggs of frogs to develop by injecting into them blood or lymph from adult frogs Although there was evidence that the white corpuscles carried on (or initiated) some special activities within the eggs, it would now seem that the beginning of segmentation may have been started merely by the pricking of the eggs with the needle of the hypodermic syringe For a few years later, Dr E Bataillon of the University of Dijon made the unfertilized eggs develop by merely stabbing them with a very fine point of glass or metal There was no introduction of any chemical substance, nor of electrical charge or "polarity" or anything else from the outside The shock alone seemed to be sufficient in some cases to start the segmentation, but in order to have the process continue there is needed the introduction of a second factor, which he believes to be a catalyzer, or activator Similar experiments made with the eggs of perch were without results, probably because the temperature of the water was not adjusted to the needs of the animals Experiments by Bataillon on the eggs of the lamprey eel, using salt water for starting the segmentation, were successful

Following up Morgan's suggestion that the physico-chemical effect of fertilization and the action of any agent used in artificial parthenogenesis were similar to a "stimulation," Dr Ralph Lillie set about to find what the common factor was in these cases He found that in the stimulation of a muscle as well as in the fertilization of an egg the first effect was an increase in the permeability of the protoplasm membrane Following up this lead McClendon tried various substances that cause the solution of red blood corpuscles and stimulation In all cases he obtained segmentation of the eggs but these substances had nothing in common from a chemical point of view, except the fact that they increase the permeability of the plasma.

From all the later experiments it is inferred that the first effect of fertilization is the loss of some substances This may be brought about by changing the permeability of the plasmatic membrane mechanically, chemically, electrically or by change of temperature; and this effect seems to be identical with the first effect in the stimulation of a muscle, or of a sensitive plant, or of a gland So far this agrees with the conclusions of Loeb But it is possible that the reason for the beginning of segmentation after the increase in permeability lies in the fact that this change brings about the removal of a substance—perhaps the product of protoplasmic activity—that interferes with further activity. A second stage, in fertilization as well as in stimulation, is accompanied by a change of electric potential at the surface of the egg—perhaps due to the introduction of new ions, in the case of fertilization, this condition may also be brought about artificially by means of mechanical, chemical or electrical agents Delage's sea-urchins and Bataillon's tadpoles give the most advanced stages in animals developed through artificial parthenogenesis. Whether it is possible to establish a mature generation of animals having only one parent, it is too early to say Histological examination may show that these animals contain the nuclear framework for only one-half of a normal animal's inheritance—as was found by Morgan to be the case in the non-nucleated egg fragments of sea-urchin in Boveri's experiment, and as was also found to be the case in the larvæ of *Thalassema* raised by Lefevre.

Whatever may be the limits for successfully inducing parthenogenetic development, these investigations must throw considerable light upon the nature of "living matter" and on the problems of heredity

New York State Barge Canal

(Concluded from page 277.)

paratively low divide in the vicinity of Rome, followed by another continuous descent, to the Hudson From this it will be seen that there are two critical points in furnishing a water supply for the canal The problem at the western end is readily solved by the abundance to Lake Erie, but throughout the history of the State canals, the question of supplying the Rome summit level has always presented more difficulties, and has led to the building of a chain of reservoirs among the hills to the south and within the Adirondacks on the north For the enlarged canal these existing sources are retained, and the two large reservoirs are added.

The work of building the dam and clearing the site at Delta, for impounding the waters of the upper Mohawk, about five miles north of Rome, is now about three-quarters done Across the greater part of the river gorge, 600 feet wide at its base, the dam has reached its full height of 100 feet above the lowest foundation When the gaps left for the river and an existing canal are closed, and the top of the dam is extended to its 1,000 feet of length, there will be formed a reservoir some four miles long and two miles wide at the base of its triangular shape, having an average depth of 23 feet and a capacity of about 20,750,000,000 gallons

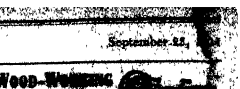
The reservoir will be of value in regulating the flow of the stream below the dam The present low-water flow is from 100 to 150 cubic feet per second, and the maximum flood discharge, of which the record is about 8,200 cubic feet per second. It is estimated that the reservoir will limit all summer floods to a maximum of 2,500 cubic feet and winter floods to about 2,800 cubic feet per second

Large artificial lakes, built for the supply of navigable canals, are relatively few in number, and, if we ignore partially natural bodies of water, like the Indian River Lake, probably there are not in existence any comparable in size with those projected at Delta and Hinckley for the use of the Barge Canal However, most larger reservoirs have been constructed for other purposes The basin at Delta will hold less than one-twentieth part of the capacity of the Salt River reservoir, in Arizona, the largest in the world, and will cover little more than one-third the area of the Ashokan reservoir of the New York city water supply

Two Latin-American Aviators

THE names of Chavez and Moissant are still household words in Peru and Central America, respectively, though for somewhat different reasons. A writer in the *Deutsche Zeitschrift für Luftschiffahrt* tells of the diverse way in which the career of these martyrs of aviation have impressed themselves upon the imagination of Latin-America.

All Peru takes pride in the heroic and disastrous feat of Chavez. The remains of his aeroplane have been transported to Lima, and placed in a prominent place in the National Museum, in the hall where hang the portraits of the 89 Spanish viceroys. Pizarro and his successors. In the enthusiasm evoked by his transalpine flight an aviation league was founded in Peru, and a Peruvian-born employee of the Blériot works—one



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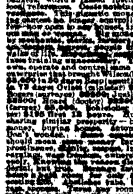
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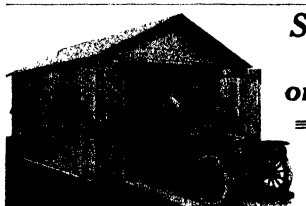
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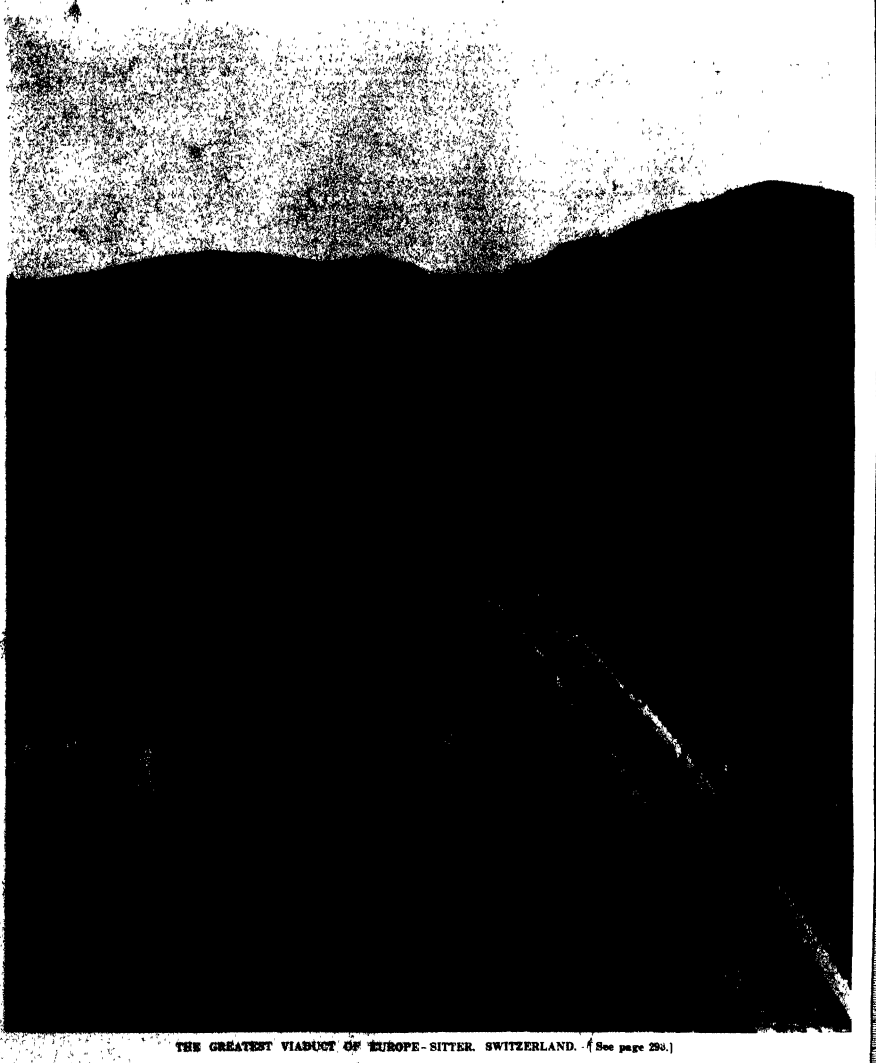
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The Ramming of the "Olympic"

SOME years ago, in the merry scramble to get home quickly from one of the America cup races off Sandy Hook, the steamer "Monmouth" found herself overlapping the yacht "Corsair" as these two speedy craft were nearing a turning buoy in the old Gedney Channel. The writer, who was aboard the "Monmouth," noting that the two vessels, in the wish to make a close turn at the buoy, were drawing very closely together, was watching the action of the bow wave and wash and wake of the one vessel upon the other. When the "Monmouth" had drawn half her length ahead of the "Corsair," the latter sheered slightly toward the "Monmouth," apparently with the intention of swinging in closely under her stern, preparatory to turning. After the "Corsair's" bow had approached slowly to within a certain distance of the "Monmouth," the yacht suddenly closed in and struck the "Monmouth." The blow was delivered as swiftly as though the helm had been put hard over for the purpose.

It was evident to the writer that the lateral force which swung the "Corsair's" bow so quickly against the "Monmouth" was due to the lateral inflow of the water, displaced at the bow of the "Monmouth," as it closed upon her stern. Naval Constructor D. W. Taylor recently investigated this matter in the course of some interesting experiments in the model tank at Washington, in which he determined the action of vessels upon one another when they are steaming in close proximity and upon parallel courses. This investigation proved that under such circumstances any two ships have a strong tendency to close in upon one another. Judging from the cabled reports, the ramming of the "Olympic" was due to conditions similar to those above referred to. The cruiser "Hawke," a relatively insignificant vessel of 7,000 tons displacement, was steaming abreast of and in rather close proximity to the "Olympic," when the cruiser's navigating officer decided apparently to pass under the stern of the big ship. He probably put his helm over to what would have been the correct amount to enable him to execute this maneuver safely in undisturbed water; but as soon as his bow swung over into the wash of the steamer the "Hawke" appears to have been drawn against the "Olympic," exactly as was the "Corsair" against the "Monmouth."

The disaster serves to show that there is safety in size. The ship which did the ramming weighs about 7,000 tons, the "Olympic" at the time of the disaster weighed probably about 60,000 tons. Judging from the speed of the "Hawke," she struck a blow which probably would have sent a ship of average size to the bottom, but so huge is the Olympic" that the enormous rent which was torn in her skin-plating and the flooding which followed seem to have had but little effect upon her stability. She was never at any time in serious danger. The extra strength and stiffness of her bulkheads rendered them amply sufficient to withstand the strain of flooded compartments. It is probable that if the accident had happened at sea and in rough weather the big ship would have made her way comfortably back to port.

The Radium Engine

IN his remarkable British Association address, Sir William Ramsay stated that the disintegration of radium liberated three and one-half million times the energy available by the explosion of an equal volume of detonating gas—a mixture of one volume of oxygen with two volumes of hydrogen. He pointed out that the major part of this energy comes apparently from the expulsion of particles (that is, of atoms of helium) with enormous velocity. "Suppose," says Sir William, "suppose that the energy in a ton of radium could be utilized in thirty years instead of being evolved at its invariable slow rate of one thousand seven hundred and sixty years for one-half disintegration, it would suffice to propel a ship of 15,000 tons, with engines of 15,000 horse-power, at the rate of 15 knots an hour, for thirty years, practically the lifetime of the ship. To do this actually requires one and one-half million tons of coal."

Here is a statement of radium's possibilities that may well give a steam engineer pause. Why bother about thermo-dynamics, about Carnot cycles, about the relative merits of turbines and reciprocating engines? Why not develop the radium engine and conserve our coal supplies, and manipulate ounces of radium instead of tons of coal? At one fell blow all our elaborate coal-conveying machinery disappears, and with it roaring furnaces, the blackened faces of stokers, and all the sooty paraphernalia that the word "steam engine" stands for.

The possibilities are far more romantic on paper than in actual fact. In the first place, where are we to get a ton of radium? Sir William himself in times past has placed the total supply of radium in the world, in laboratories, at much less than a pound. Physicists and chemists have time and time again pointed out the enormous personal risk involved in handling even a half grain of comparatively pure radium. Bacteria, insects and even mice, we believe, have actually been killed by radium rays, suitably applied, to be sure. What will be the effect upon a man sitting in a room containing, let us say, ten pounds of radium? Would he ever emerge alive? Obviously, the mere difficulty of handling so terrible a substance imposes problems far more difficult of solution than those which the old steam engine ever offered.

Assuming that we really had a safe method of handling a large quantity of radium, how are we to make its energy available in practical form? Some totally new type of prime mover must be developed, some contrivance which will render it possible for electrons hurled into space with the speed of light to do their work.

Then again there is the subject of materials to be considered. Radio-active substances are no respecters of ordinary containers. The particles projected from radium permeate most substances with comparative ease. To confine them would be a far more serious task than the insulation of a steam pipe.

Stupendous as the problem is, who shall be bold enough to say that it will never be solved? After all, is the utilization of the enormous energy contained in a half grain of radium any more startling than the transformation of the energy sent up in a shovelful of black coal? If the radium engine ever does come, it will simply be another instance of the triumph of mind over matter.

From the Complex to the Simple

A MARKED step was taken in the simplification of prime movers when Watt's cumbersome beam engine, with its ingenious but elaborate parallel motion, gave way to the present standard reciprocating type, with only piston rod, cross head and connecting rod interposed between piston and crank. An even greater advance toward ideal simplicity occurred when, after years of effort by inventors to produce a practical rotary, Parsons brought out his compact, though costly, turbine, in which the energy of the steam is developed on a zigzag path through multitudinous rows of fixed and moving blades.

And now comes Mr. Tesla with a motor which bids fair to carry the steam engine another long step toward the ideally simple prime mover—a motor in which the fixed and revolving blades of the turbine give place to a set of steel disks of simple and cheap construction. If the flow of steam in spiral curves between the adjoining faces of flat disks is an efficient method of developing the energy of the steam, the prime mover would certainly appear to have been at last reduced to its simplest terms.

The further development of the unique turbine which we describe elsewhere will be followed with close attention by the technical world. The results attained with this small high-pressure unit are certainly flattering, and give reason to believe that the addition of a low pressure turbine and a condenser would make this type of turbine as highly efficient as it is simple and cheap in construction and maintenance.

Lessons of the Transcontinental Flight

ON September 12th and 13th two biplanes, a Wright, piloted by Robert G. Fowler, and a Curtiss, driven by James Ward, left San Francisco and New York, respectively, in an attempt to fly across the continent in less than thirty days. Under the rules the flight must be finished by October 10th. In view of the automobile record of fifteen days, the flyers thought they had ample time, even allowing for accidents. Special trains with several extra machines were reported to be in close pursuit, and if any accidents were met with, it was expected that repairs would be promptly made.

Aviator Fowler made an excellent start on September 12th, circling over the Golden Gate and San Francisco Bay and making his first stop at Sacramento. After replenishing, he continued on to Colfax in the foot-hills of the Sierras. He was just beginning the long climb of more than 5,000 feet to the summit (7,018 feet) when, at Alta, the control wire of the vertical rudder broke and he came fluttering down in spirals. The machine was badly broken, but Fowler fortunately was not seriously injured. A delay of ten days occurred before the biplane was ready to fly again.

The start of Ward from Governor's Island on the 13th seems to have resulted in the bad luck generally attributed to that number. Little Ward is the youngest and lightest aviator of the transcontinental race trio. After losing his way at the start, he was delayed by motor troubles of various kinds, chiefly by lack of lubrication, due to faulty operation of the oil pump or leakage of oil from the crank case. Even after testing his new motor thoroughly on *terra firma*, he was unable to fly many miles before he was forced to alight for further repairs. In alighting he hit a tree and smashed his machine again, which caused him to abandon the race.

An excellent start was made by Calbraith P. Rogers on Sunday, September 17th. Rogers, who like his brother, Lieut. Rogers of the Navy, flies a Wright biplane, departed from Sheepshead Bay at 4:38 P. M. on Sunday. He flew directly across Brooklyn and New York, crossed the Hudson opposite Madison Square, and picked out the Erie tracks by means of white streamers that had been placed on the ground along the line of the railroad. He flew without a stop to Middletown, N. Y., where he arrived 1¾ hours after his start from Sheepshead Bay. The total distance covered was 84 miles, which corresponds to an average speed of 48 miles an hour. In starting from the race track at Middletown the next morning, Rogers came to grief and smashed his machine. The place from which to start was very restricted and the machine was unable to lift the heavy six-foot-four aviator quickly enough to avoid a large willow tree directly in his path. Rogers skillfully turned aside and cleared the tree, only to hit the top of another tree, which upset his machine and tumbled it to the ground. Rogers landed upon his feet after a fall of 30 feet or more and was uninjured, but his aeroplane was badly smashed. In four days, however, he had secured new parts and reconstructed his machine, and on September 21st, at 2:29 P. M., he left Middletown. With a strong, favorable wind to aid him, he covered 80 miles or more in 1 hour and 6 minutes, and alighted at Hancock at 3:35 P. M. The next day he covered 250 miles in all, but got off his course at Susquehanna and made a detour to Scranton, Pa., before reaching Binghamton. He was over 6 hours in flight and finally reached Elmira.

The results of the race to date have demonstrated that training in cross-country flying is essential in order to make a good performance in a race of this kind. Rogers' accident was due to faulty judgment, but besides this he wandered from the course owing to his inexperience in cross-country work. The accident which happened to Fowler is one which should not happen to any well-made aeroplane. This is not the only time that a control wire has broken on a Wright machine while in flight. The delay caused by the breakage of his rudder wire may cost Fowler the race. He is indeed lucky that he escaped without serious injury, as the vertical rudder is considered by the Wrights to be quite essential to their system of control. Using the warping alone Fowler managed to descend in spirals, but he was unable to pick a suitable landing place.

Power from Sunshine

An Installation of Sun-Power Plant



THE direct utilization of the natural forces in the development of power suitable for human activities has been for centuries a matter of continued scientific research.

To a limited extent these forces have been used from the dawn of civilization in the common forms of the windmill and various types of water-driven motors. It has not, however, been hitherto possible to practically utilize the central dominating forces of nature—the sun's heat—in any direct manner, though obviously all power generators are dependent upon this great source for their existence.

For many years engineers and physicists have been occupied with this problem; notably Ferry, Millochan, Mouchat and Tellier in France; Gilntner and Althaus in Germany; and Langley, John Ericsson, and Wilsie in America. These experimenters based their efforts either upon the use of lenses or mirrors to concentrate the sun's rays upon a small surface, or upon the heating of fluids of a low-boiling point, with subsequent power generation from the vapor under pressure. It has always been attempted to create vapor at high pressure, and then utilize this in the ordinary engine, but with the high temperatures involved, the losses by conduction and convection are so great that the power produced was of no commercial value. Where lenses or mirrors are used, the primary cost of the lenses, and the apparatus necessary to continuously present them toward the sun, have rendered them impracticable

Where fluids of low boiling point, such as ether, sulphurous acid, and liquid ammonia were used, the results were of little value by reason of the inherent inadequateness of these fluids as power generators.

A sun-power plant, in order to be practicable, must possess, first, high efficiency, low cost of installation and maintenance; well-marked length of service, and should not require specially trained mechanics for its operation

In order to be efficient, it is not necessary that the plant generate continuously, inasmuch as the great value of such a plant lies in its use as an irrigation apparatus; it is only necessary that the plant run about eight hours daily. It must, however, consist of units which may be assembled to produce a power plant of any required size, the larger the plant the greater the efficiency It is entirely practicable to produce a sun-power plant in this manner up to 10,000 horse-power and over. An ideal plant must be subject to little accident; hence, it must lie near the ground in order not to be affected by storms and winds. Each unit must be repairable without stopping the operation; construction must be simple and easily understood by the ordinary steam engineer; and wear and tear must be reduced to a minimum.

The first cost of a sun-power plant to be practical, and of commercial value, must be sufficiently low so that the interest on the investment does not make it unprofitable. This is the rock on which, thus far, all sun-power propositions were wrecked. It is not necessary that the cost of the sun heat absorber shall be as low as that of a steam boiler and fitting of the same power. The cost of the plant described herein is twice that of the ordinary steam-power plant of the same size. This price is sufficiently low, however, so that even if the extra fuel is taken into consideration, the fact that after installation no fuel is required, is such an enormous advantage as to entirely offset the increased cost, and in addition cause great profits.

Some ten years ago the writer became interested in the problem of obtaining power by absorbing the sun's rays. It was found, by experiment, that if a vessel were so arranged that the sun's rays could impinge upon it, and if all heat losses by conduction, convection and radiation were prevented by a theoretically perfect method of insulation, the temperature within the vessel would rise certainly to a thousand degrees Fahrenheit without any attempt being made to concentrate the rays of the sun. For commercial purposes it is impossible to secure any form of insulation which would even approach the theoretical. Commercially, the main object is to produce practical power at a minimum cost, and this has been done by the use of well-known and cheap forms of heat insulation

Were no steam made in these vessels, as they are arranged in the present plant, the temperature therein would go up to 350 deg. F. in latitude 40 north, possibly easily to 450 deg. F near the equator. The production of steam at atmospheric pressure, however, keeps the temperature in the vessels down to 212 degrees, and whatever excess of heat is produced by the sun's rays over and above that lost, is converted into steam, and may therefore be utilized

The experience of additional years will, no doubt, lead to designs considerably better than this first attempt on a commercial scale. Sun power must go through the same long and gradual course of development that has brought other forms of mechanical power to the present high plane of efficiency but the principle will remain fundamentally correct

With this idea in mind the first Shuman generator was built. It consisted of a wooden box covered by two layers of glass, between which was a small air space, and in the box was placed a miniature ether boiler. This apparatus was exposed to the sun's rays, the ether distilled, and the amount of heat which might be absorbed was determined. As an experiment, a small toy engine was successfully run with this original apparatus. A second generator consisted of a 2-inch steam pipe 16 feet long, insulated at the bottom, and inclosed in a box covered by a double layer of glass. Here again ether was distilled, and the number of heat units absorbed were determined. A third type of power plant was composed of a bed of water pipes properly insulated against heat loss, the unit being 18 x 60 feet, and the motor being an ether engine. With this apparatus 3½ horse-power was obtained. With the knowledge so gained, the present generator, to be described below, was gradually evolved.

The sun-power plant in its present development consists of the absorber, a low-pressure steam engine, condenser, and auxiliaries

The absorber, in a general way, is composed of a series of units, each containing a flat metal honeycomb water vessel rectangular in shape, and resembling closely a large waffle. This vessel is inclosed in a flat wooden box covered with two layers of glass having a 1-inch air space between them, and having the under surface of the box insulated against heat loss downward by a 2-inch layer of regranulated cork and two layers of water-proof cardboard.

The boxes are mounted on supports which elevate them some 36 inches above the ground, and which permit them to be inclined perpendicular to the sun at the meridian. These adjustments of the inclination need only be made about once in three weeks.

Plane mirrors of cheap construction are mounted on two sides of the boxes in order that more rays of the sun may be absorbed and reflected upon the surface of the water vessel. This latter is connected at one end to a feed pipe from the water supply, and at the other end to a steam pipe. The steam pipes from the various units are connected together and empty into a main 8 inches in diameter in the present plant, which conveys the steam to the engine

The engine is a new type low pressure, reciprocating steam engine of great steam economy. Connected with it is a condenser of ordinary type and auxiliaries such as may be found in any condensing plant. The water from the condenser is pumped back into the absorber, thus insuring a continuous closed circuit whose only water loss is from accidental leakage, which is carefully guarded against

The power of this first plant is used for pumping water by means of a reciprocating steam pump of the ordinary type and whenever the sun has shone during the past six weeks, this plant has pumped water successfully and practically. The capacity of the present plant in this latitude, is 3,000 gallons of water per minute, lifted to a height of 11 feet

From actual tests made in Philadelphia in August, 1911, it was found that from the absorber of 26 banks of units, each containing 23 single units and having a light absorptive area of 10,296 square feet and an actual area of 5,148 square feet there could be developed during eight hours 4,825 pounds of steam. The power produced was much lower than normal to the plant, as it was built for tropical use and was entirely unfitted for commercial work in northern latitudes

It is found by observation that the steam generated in a sun-power plant is reduced largely by humidity and the presence in the air of smoke haze etc. It follows, then, that the efficiency will be greatly increased when the apparatus is tested in a dry climate free from atmospheric impurities attendant upon proximity to a large city. The plant was set up at Philadelphia not because it was considered to be a commercial thing there but because the necessary experimenting with a new plant thousands of miles from home would have been exceedingly expensive. Within a month or two this plant will be taken down and erected in Egypt. This can be conveniently done, as the entire heat absorber is practically portable

Again the loss of heat by conduction and convection in northern latitudes is enormous. If the present apparatus is placed in an average air temperature of 100 deg. F., such as obtains throughout all equatorial regions it is safe to assume that the power will be multiplied three-fold

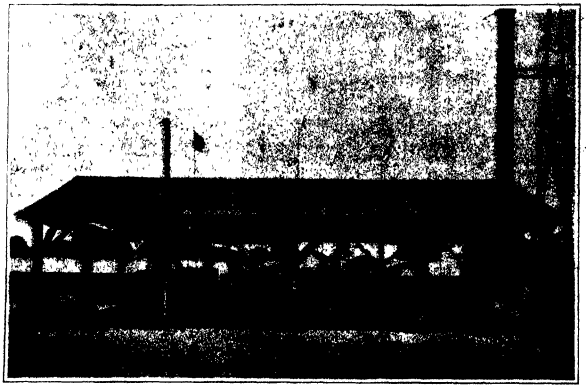
Having described the mechanism of the sun-power plant, it remains to discuss the opportunities for its use. The immediate opportunities for sun power are in those regions in the tropics where the sun practically shines throughout the year, and fuel is very expensive, coal costing in some localities $30 per ton

There is room now for at least half a million horse-power in such tropical fields as the nitrate district of Chile, the borax industry in Death Valley, and for general purposes in places where the outside temperature runs from 110 to 140 degs. F

As an irrigation engine there is no limit to the amount of power that can be practically utilized, and for this purpose the conditions need not be so very favorable as those mentioned above. Throughout most of the tropical regions *sun power will prove very profitable in irrigation*. One advantage of the sun power, or, in fact, of any condensing plant for irrigating purposes, is that the water used for the condenser costs nothing, as the main output of the engine can be passed through the condenser first be-

fore entering the irrigating canals for distribution.

The interior of Australia was, at one time, a fertile country, as is evidenced by the fossilized trees. Here is an area of some 600 miles in each direction which is entirely valueless. During a drought there have been times when one-third of the sheep raised on the margins of this desert died from thirst, causing great financial loss. In this locality the sun shines with an intensity sufficient to produce an average daily



Front view of engine, auxiliaries and water pump.

temperature of 100 to 140 degs F. The occasional rains nourish the sparse vegetation necessary for sheep, which are watered from wells driven in the ground and pumped, generally by horse power, very often by hand, and sometimes by means of fuel oil, which, by the time it reaches its destination, brings the coal equivalent up to some $20 per ton. By building sun engines in this region, and pumping from the always present underground water which in this region lies at a depth of from 15 to 40 feet, this country can be made productive and valuable.

Throughout Eastern India and Ceylon many thousands of square miles of farm land can be improved three fold by mechanical irrigation. Hand pumping is mainly the present form of irrigation used.

In Egypt agriculture depends entirely upon irrigation furnished by the River Nile through its periodic overflow. The English government built the Assuan Dam at an enormous expense, and widened the irrigable area about half a mile on each side of the Nile, thus adding greatly to the tillable portion of Egypt. Of course, when the Nile is in flood infinitely more water than necessary is furnished, but the demand is for a supply which can be depended on from day to day, especially at seasons of low water. This supply at present is furnished by the hand labor of some 100,000 fellaheen who pump by means of the shadoof method. One sun engine, such as is now erected in Tacony, will do the work of about a thousand of these laborers.

Throughout Arizona, Nevada, New Mexico and Southern California there is room for any amount of power for irrigating purposes alone. These States show an average of 90 per cent sun light, and the cost of fuel is practically prohibitive in most of this region.

To summarize all of the above statements it may be assumed that 10 per cent of the earth's land surface will eventually depend upon sun power for all mechanical operations. Given inexhaustible power, which is, of course, always obtainable from the sun, and utilizing the nitrogen in the air for fertilizer in the form of nitrates and such compounds as calcium cyanamide, the human race will be enabled to draw directly on the source of all life for power and sustenance.

A question of paramount importance in the possibilities of a general use of sun power is the cost of the apparatus.

In the Shuman type of sun-power plant, the engine, condenser and auxiliaries are similar to those in daily use by steam plants and may therefore be eliminated from comparison; leaving the absorber and the ordinary steam boiler alone to be compared. It is found that at this time the initial cost of the sun-heat absorber in question is about double that of a first-class boiler plant of equal power.

The great economy occurs in the item of fuel. In districts especially suitable for sun power the cost of coal, or its equivalent, is usually very high, the price ranging generally from $10 to $30 per ton. To offset this, no fuel at all is required by the sun heater.

In the matter of maintenance and repairs also the advantage lies with the sun power. It is estimated that the repairs should not be in excess of 5 per cent per year on the initial cost, inasmuch as the apparatus works at low temperature, while the ordinary boiler requires flue gases up to 2,500 degrees. This cost of the parts must manifestly be much greater in the latter form of power plant.

Many parts of the sun-power plant, such as the metal heaters, piping, foundation and insulation, are practically everlasting, barring accidental breakage, the only item of repair being the wooden frames and glass covers, and it is found that after an installation of glass has once been tested out by the heat, and the badly annealed sheets replaced, the remainder will last for years. This was evidenced by the small 18 x 60 feet heater in operation for three years in Philadelphia. There was a replacement of about 10 per cent necessary during the first three weeks; thereafter the heater ran three seasons and only two or three sheets of glass needed replacement, these being accidentally broken.

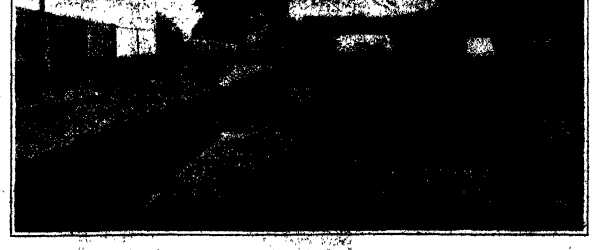
There is now being tested out a celluloid-like material having all the necessary properties of glass and being flexible and capable of manufacture in large sheets. The use of this substance will not only greatly reduce the cost of installation of sun-power plants, but will make repairs a factor of but slight importance.

It may also be said that the large area covered by the sun-power plant would add greatly to the expense, but inasmuch as these plants are intended for use where the cost of land is very low, such criticism is not valid.

The future development of solar power has no limit. Where great natural water powers exist, sun power cannot compete; but sun-power generators will, in the near future, displace all other forms of mechanical power over at least 10 per cent of the earth's land surface; and in the far distant future, natural fuels having been exhausted, it will remain as the only means of existence of the human race.

The Current Supplement

THE rumor of the birth of synthetic rubber makes us look with renewed interest at those industries in which India rubber is worked up into various articles. A review of the Present Status of the Rubber Industry forms one of the principal topics in the current SUPPLEMENT, No. 1865.—The fifth instalment of Prof. Turner's article on The Great Star Map continues his discussion of the subject of star positions.—The length and character of wood fibers is a subject of interest both to the botanist and to those who carry on industries using wood as a raw material. The subject is discussed in a brief illustrated article.—Every now and again a seemingly new disease becomes fashionable. A case of this kind is appendicitis, which for some years past has sprung into remarkable prominence. The question naturally arises, Is it really a new disease, or if not, how came it to escape our notice until recently? The discussion of this question by a French physician has appeared in *Cosmos*, and is reproduced in this paper.—A striking new development, along the lines of Lodge's classical experiments on Fog Dissipation, comes to us from California, where Prof. Cottrell has successfully applied electricity for the precipitation of fumes occurring in manufacturing processes. The report of his work, abridged from the *Journal of Industrial Chemistry*, is incorporated in the current issue.—The economies resulting from the use of fitting nozzles in foundries are expounded by H. F. Stratton.—A simple electroplating apparatus is described.—A. Emerson tells of a newly discovered portrait of Constantine the Great.—Two short articles are devoted to phases in the plant industry, the one on the recovery of useful products from willow bark, the other on a device for testing cereals for their resistance to disease.—The second instalment of F. P. Valentine's valuable paper on Problems in Telephone Traffic Engineering appears in this issue.



Safety valve blowing off at one-half pound above atmosphere.

PRESSING THE SUN INTO SERVICE

The Sitter Viaduct

A Remarkable Swiss Engineering Work

By the Paris Correspondent of the Scientific American

ONE of the most remarkable works in Switzerland, noted for its wonderful engineering structures, is the Sitter Viaduct. This is indeed the highest structure which the Swiss engineers have yet built. The viaduct lies on the line of a newly-built railroad known as the Bodensee-Toggenburg line, and is situated on the section of railroad lying between St. Gall and Watwil. It is built in a very picturesque site, where the Sitter torrent after joining the Urnasch stream, has worn down a deep cutting between the rocky faces of the adjoining heights. The railroad lies on the higher level, whence the need of a long viaduct in order to span the valley.

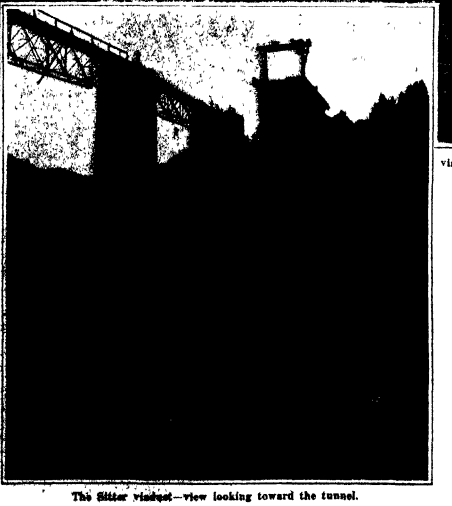


The great Sitter viaduct—eastern aspect

The total height of the viaduct is 1,180 feet. There is a middle space of about 400 feet which is bridged over by a single steel truss noteworthy as being the longest in Switzerland. The engineers were obliged to resort to some very original measures on account of the local difficulties. The great steepness of the slopes of the valley allowed but little space for handling the material. There is no space on the upper ground at the left-hand end, since the mouth of the Stuckenegg tunnel is quite close to the steep bank. It was decided to use a system of cableways for handling the greater part of the material.

The main stone arches have 187 feet span, and several stone columns of unusual size enter into their construction. The highest of the piers is about 40 feet square at the base and runs up to 262 feet height. The viaduct has four such arches of 82 feet span, then comes the steel span, and on the other side there are two arches of 82 feet span and five small arches of 40 feet.

To build the steel truss high above ground a timber scaffolding of original shape was used. The base takes up but a small space. It was designed to stand the weight of the bridge truss, as well as the strong wind pressure. It sustained no damage despite storms and floods. An interesting operation was the construction of the truss span on the scaffolding. An electric elevator first installed on the lower platform and running to the top took up the iron parts for building a 12-ton cable hoist at the top level. When the hoist was in place it could be used to draw up the iron work which was needed in building the main bridge span. Meanwhile an air compressor plant had been installed for operating the pneumatic riveters for the bridge. In this way was built the middle part of the bridge truss to a length of 120 feet. Then came the task of building the rest of the length so as to reach the stone pillars on each side and cover the whole opening. In this case a good part of the truss overhangs the tower on both sides. The work was easily carried out by using a heavy traveling crane which runs on a track along the top level, as will be observed in one of our photographs. The crane had to be built on the top of the tower by material which was hoisted up from below. It could then be used in handling all the heavy iron parts in order to build the overhanging portions of the bridge on both sides of the tower so that at last the ends of the truss could be placed upon the stone piers which were to support them.



The Sitter viaduct—view looking toward the tunnel.

A GREAT SWISS ENGINEERING WORK

Abstracts from Current Periodicals

Phases of Science as Other Editors See Them

Our Backwardness in Invention

WE recently reprinted from *Engineering News* some comments on the encouragement of invention in Europe and the discouragement of invention by the large corporations of this country. As the result of a rather lively letter written by Mr William Kent, of Montclair, N J., to the *Engineering News*, the editor of that paper takes up the subject again In reply to the *Engineering News* statement that "We are to-day something like five years behind Germany in iron and steel metallurgy," Mr Kent gives a list of improvements which have been made in blast furnaces, steel works, hoisting and conveying apparatus, foundry machinery, gas-producers, rolling mills, and machine tools

The *Engineering News* recurs again to our backwardness in adopting the Diesel engine. "Notwithstanding the fact that the basic patents have expired so that any concern may build it, only a single firm in the United States to-day is selling Diesel engines" says the *Engineering News*, "and even this concern is not yet on a basis to push them on the market in competition with other machines.

In oil engines, the principal business in the United States has been done by a German concern manufacturing an engine invented in England In the development of gas-producers and suction gas engines most of the work done in this country has followed after the pioneer work done on the other side, and, notwithstanding the great stimulus to the use of the gas engine afforded by our stores of cheap natural gas, the internal combustion engine for power purposes is far more largely used abroad than here"

On the subject of the steel and iron industry, and the advance made by Germans, the *Engineering News* has this to state "It is perfectly well known that the blast furnace gas engine was fully developed and in successful commercial use in Europe about five years before it was taken up here" Our contemporary goes on to say that eleven years ago blast furnace gas engines were in use in Europe, which was about four years before the first blast furnace gas engines were installed at the Buffalo works of the Lackawanna Steel Company, cited by Mr Kent as an example of American up-to-dateness

In the electrical manufacture of steel, *Engineering News* points out that European inventors did the pioneer work, and that electric smelting furnaces were in extensive commercial use in Germany before American inventors thought it worth their while to take up this new invention

"The pioneer American steam turbine inventor, Dow, lacked the commercial knowledge to make his invention a commercial success, nor was he able to secure capital to develop it So the honors for pioneer work go to De Laval, the Swedish engineer, and to Parsons, the Englishman, while Curtis, another Englishman, and Rateau, a Frenchman, and Zoelly, a Swiss, and Riedler and Stumpf, in Germany, are the engineers who have won distinction in the later development of the steam turbine

"As for the multi-stage centrifugal pumps and blowers, these were in extended and successful use abroad years before they were taken up in the United States France developed the automobile far ahead of either England or America Telferage was originally invented by an English professor of engineering

"As for pioneer inventions in the railway field, the most important developments of the past five years in this country in locomotive design have been the Mallet locomotive (invented by the French engineer, Antoine Mallet, in 1888), and the use of superheated steam, for which credit must be given to the German, Schmidt"

In the opinion of our contemporary "The United States no longer leads the world in the race for invention, but it is better to know the truth than to delude ourselves with false pretensions to supremacy

"And now, as to the reasons why this country no longer leads It is not because American engineers and inventors are less ingenious or less progressive than those of other countries, though it may well be that the thorough work done by the German technical schools gives them some advantage in the development of inventions requiring a high degree of scientific knowledge

"We said in our former issue, and we now repeat, that the main reason, in our opinion, is that under the present organization of American manufacturing industry, invention and innovation is discouraged rather than encouraged And this opinion is based, not alone on knowledge of the actual experience of numerous American inventors and engineers, but on the frank statement of officers connected with some of our large industrial corporations

"We could cite the case of an American inventor who, after vainly endeavoring to secure capital for his work in his native country, went to England and won fortune, fame and honor. Another particularly pertinent example is the Gray beam mill, cited by our correspondent above as an example of American supremacy in pioneer inventions.

"The facts are that the inventor of the Gray mill for rolling wide-flange I-beams, after developing his invention and actually demonstrating its merits, was unable to market his invention with our excellent steel magnates They were not *obliged* to have his invention. They were making money by the cartload in consolidation and promotion and stock market manipulation. Why should they bother with such a trifle as an improved system of rolling beams?

"Mr Gray therefore went abroad, and the Belgium steel plant at Differdingen promptly took up his invention and developed a large and profitable business thereby Returning to America after this success abroad, Mr Gray was even then unable to secure a favorable hearing from the steel mill managers, whom Mr. Kent praises so highly It was not till the Belgian plant had been rolling Gray beams for five years that Mr. Schwab took it up at Bethlehem This former Steel Corporation president, engaging in a strenuous campaign of competition, may, perhaps, for this reason, have been more receptive to new ideas At any rate, the success of the 'Bethlehem beams,' and the tardy imitation of these shapes by other American steel mills, justifies his venture and proved the ultra-conservatism of those managers who, years before, rejected the Gray rolling process.

"We are well aware that the huge industrial combination has some advantages in undertaking the development of new inventions over the small concern. We are aware that some of our trusts do maintain research departments and it is currently said that one important use of these departments is to defeat the independent inventor and discourage the undertaking of original invention in the field which the trust aims to control. We are well aware, too, that there are numerous lines of labor-saving machinery which have been developed in the United States, but not abroad, because of the great difference in wage scales here and there All this has nothing to do with our contention that the United States has lost its supremacy as a field for the development of pioneer inventions, and that in the race of international competition we are failing behind because of the attitude of the trusts toward inventive progress."

A New Material for Safes Which Resists the Oxy-acetylene Blow-pipe

SAFE makers and safe breakers are engaged in a contest similar to that of the makers of guns and armor plate Safe breakers' methods have lately been much improved, especially by use of the so-called autogenous welding process which makes it possible to penetrate iron and steel plates of great thickness in a short time by means of the oxy-acetylene flame. This advance in criminal practice has produced corresponding improvements in the construction of safes and vaults. Lately the well-known armor plate makers, the Krupps of Essen, have produced a new material which is especially suitable for the protection of safes and vaults, as, according to a note in the journal *Autogene Metallbearbeitung*, it cannot be fused or penetrated by the oxy-hydrogen, or oxy-acetylene burners now in use, or at least it offers so great a resistance to fusion that an inordinately long time and enormous quantities of gas are required. The material is a variety of cast steel which is extremely hard and resists the best boring tools, so that it affords security also against mechanical forcing In order to make a hole 80 millimeters (3.2 inches) in a plate of this material, 40 millimeters (1.6 inches) thick, with the oxy-acetylene burner, from 6 to 14 hours' time, from 2,750 to 4,550 gallons of oxygen and from 2,500 to 3,700 gallons of acetylene are required, according to the results of a number of experiments The average safe breaker has not so much time or so much gas at his disposal. One of the steel cylinders in which compressed gases are transported contains about 1,460 gallons of (uncompressed) gas and weighs about 150 pounds. According to the most favorable results given above, at least four such cylinders would be required and their transportation, in addition to that of the other apparatus needed, is a task to stagger the boldest safe cracker. The extraordinary hardness of the plates opposes no serious obstacle to working them in the shop, as the rivet holes required can be made directly in the casting or they can be bored in softer steel parts especially provided for that purpose. The only defect of the plates is the present impossibility of making them thinner than 1.6 inches. It appears not improbable that this difficulty will be overcome, for only a year ago it was impossible to make the plates of less thickness than 8 inches, in which condition, of course, they were practically useless for the construction of safes and treasure vaults.

Heredity in Potatoes

IN the first number of *The Journal of Genetics*, a new journal devoted to problems in heredity, Dr. R. N. Salaman gives some results of a prolonged study on the inheritance of certain characters in the common potato (*Solanum tuberosum*).

Mendelian behavior was found in the sterility of the pollen in certain varieties, the sterility being dominant. Most of the experiments related, however, to the tuber. In regard to length, the tuber behaves, in inheritance, like the stem of the pea plant. The long type is dominant over the short. That is, where two varieties were crossed, one having short round tubers and the other long tubers, all the potatoes of the next generation were of the long type. But on breeding these hybrids by self-fertilization, the following generation gave three plants with long tubers to one plant with short tuber, in the typical Mendelian fashion The long tuber has more "eyes," which the author considers equivalent to nodes.

In some potatoes the eyes lie rather deep in the tuber, while in others they are near the surface, or quite on the outside When these two characters are brought together in fertilization, the deep eye character is dominant over the other.

The color of the tuber depends upon the amount of the pigment "anthocyan" present in the cell-sap of the superficial cells of the tuber, and varies from red to deep violet On analysing the results of the experiments, it appears that there are three distinct factors that have to do with the color appearance of a potato These are (1) a factor for redness, (2) one the purple or violet, and (3) a color "developer." Without this third factor no color appears at all The other factors determine the character of the color. The purple appearance depends upon the presence of all three factors; this is dominant over the red, and this in turn is dominant over the white, or absence of pigment.

In the study of another species of potato (*Solanum etuberosum*) for comparison, Mr. Salaman found some curious results In this species whiteness of tuber was dominant over pigmentation, roundness was dominant over long form, and superficial eyes dominant over deep-set. In all three respects this species is just the opposite of our garden variety

Incidentally it was observed that the sterile individuals in every culture were much more resistant to the potato-rot (*Phytophthora infestans*) than the ones bearing fertile pollen. This is a mater of great practical importance, since it may be possible to establish a race quite immune to this disease. As the sterile individuals are dominant, this resistance would appear to be of a different type from the resistance of wheat to the wheat-rust (*Puccinia graminis*) which was found to be recessive in the Cambridge experiments. It is a simpler matter to establish a race bearing recessive characters, but it may be possible to find a combination of characters in a potato that will include immunity to the rot.

The Cost of Substituting Steel for Wooden Cars

ACCORDING to an estimate in the *Railway Age Gazette*, the cost of substituting steel cars for the present wooden cars is estimated at about $400,000,000. At the beginning of this year there were about 2,000 passenger cars in service in this country, built of all steel construction. The total number of passenger coaches is about 54,000 so that the number of steel cars is about 3.3 per cent of the total. Of the cars constructed during the present year, 62 per cent will be all-steel construction, so that at the end of this year fully 9.3 per cent of all passenger cars will be of steel, while 3.5 per cent have steel underframes. The percentage of wooden cars in service has dropped in the last three years from 99.1 to 90.2 per cent.

Correspondence

[The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.]

Free Ships vs. Discriminatory Duties

To the Editor of the SCIENTIFIC AMERICAN:

The statement that the United States pays from $200,000,000 to $300,000,000 to foreign steamship lines for carrying passengers, freight, and mails is correct, with the sum nearer the $300,000,000 mark.

It is an economic fact also that under present conditions it is cheaper to pay foreign steamship lines for performing these services than to attempt it with American-built tonnage aided by subsidies or discriminatory duties.

Such a state of affairs is, in the long run, detrimental to all American interests. In the case of two European nations, if not three, their mercantile fleets are practically dependent on American traffic for existence. Our present system keeps alive our sea rivals and hinders the development of our export trade.

That the United States should be restored to their old position in the deep-sea trade, is imperative from a political as well as from an economic standpoint. Without an adequate merchant marine as an auxiliary to our navy, our battleship fleet is like a hull without an engine—only half equipped for its work.

We have a big navy, and it is growing larger all the time, yet it is as dependent to-day on foreign built and owned steamers for transports, colliers, etc., as it was when the Spanish war broke out. The United States paid some $20,000,000 or more then for the obsolete tonnage that foreigners dumped on Uncle Sam.

The views of Mr. Bowles, formerly an admiral of the United States navy, now president of the Fore River Ship Building Company, are entitled to great respect.

His company is building the two battleships for the Argentine navy, and it has turned out some high-class coast freighters. His statement, therefore, "the experience of sixty years of 'free trade' in ocean transportation conclusively shows that it is not profitable to American capital under present conditions, and requires protection or some form of government aid or subsidy," merits marked consideration.

Mr. Bowles seeks to overcome conditions of "free trade" which exists in the deep-sea trade by the application of "protective principles:"

"First, by mail compensation such as is provided for under the ocean mail act of 1891 and which is still in effect.

"Second, the remission of the head tax of $4 when immigrants arrive in the United States in American registered steamers.

"Third, by discriminatory duties applicable to American-built steamers of all types. . . A reduction of 5 per cent on all goods on which the ad valorem duties exceed 41 per cent, and on all goods under 41 per cent or free the importer shall receive an importer's certificate available only for the payment of duties at the custom house and equal in value to 2.05 per cent of the value of the goods so imported."

The mail compensation act is still in effect, but it has done little good so far; it could be made of value in establishing new lines if American capital were generally employed in ocean shipping under the American flag.

The second proposition, the remission of the head tax of $4 when immigrants arrive in American steamers. It should be amended by establishing a stamp tax of $4 on all outward emigrant tickets, the same to be remitted in case the passenger sails on an American steamer.

Foreign governments do not hesitate to legislate to make the emigrant traffic a source of profit to the State and to the upbuilding of their merchant marine.

Third: The discriminatory duty." This is highly objectionable. The refund to the steamer or the importer would run from $2.25 per ton on sugar to $4.50 on a ton of coffee.

These articles, as well as hides, flax, fruits, fibers, are imported in cargo lots. An American steamer operated under such discriminatory duties would earn approximately 50 to 100 per cent more than a foreign steamer in the same trade. Under such conditions the American steamer would control the traffic in such commodities, and the control of the import would carry with it the control of the export, and subject exporters to such rates of freight as the traffic would bear.

It would almost to a certainty create a monopoly in the deep-sea trade as effective as now exists in the coastwise.

Although the United States have never tried the policy of "free ships" for upbuilding our merchant marine, the advocates of subsidy and discriminatory duties have always denounced it as a fallacy, yet those nations which have adopted it, are the most progressive and successful ship-owning nations.

For over one hundred years our shipbuilders have been shielded from the competition of foreign builders; this has resulted in developing our coastwise and lake shipping, but it has steadily lost us the deep-sea foreign trade till it is now practically extinct. In justification of this, it is stated that it costs from 40 to 50 per cent more to build steamers of the same size in American yards than in foreign. This would seem to indicate that the American prices are excessive.

It is also true that shipbuilding material may be imported free if used in building American steamers engaged in foreign trade. This privilege, however, is so hedged about with restrictions as to be practically valueless.

"Shipbuilder's (American) labor costs are 70 to 100 per cent more than the foreigner."

This is also equally true of labor engaged in making everything, from needles to automobiles, ship plates, and rails. Yet we are constantly exporting a greater quantity of all kinds of these and other manufactured goods every year. And if the American scale of wages can be paid on American goods sold in foreign markets in competition with goods of foreign manufacture, it would not be unreasonable to expect that our ship builders could compete with the foreign builder on steamers built for foreign trade only.

In the case of the two battleships being built for the Argentine government, it was done. The contract was secured in competition with foreign competitors, and it is to taken for granted that the labor employed in building these ships receives the American wage scale.

It is stated that to build the hulls of the battleships costs more in the American yards, but that Americans can turn out big guns and armor plates so much cheaper than can the foreigner, that the total cost of building in American yards is less than the foreigner's price.

It is something to be proud of—to be able to build armor and big guns cheaper than can European concerns; and as this is the case, it is somewhat difficult to see why steamers cannot likewise be built cheaper in American yards. The labor in gun and armor making is as well paid as labor employed in shipbuilding. A few years ago Krupp offered armor plate to the United States at much under the American prices. Now apparently American makers can undersell Krupp.

Justification for denying American registration to foreign-built, American-owned tonnage is that it costs more to operate the foreign-built under the American flag and that Americans would not avail themselves of the privilege.

Congress has been petitioned to pass such a bill, and assurances were given that on its passage a fleet of modern fast boats would be enrolled under the American flag for foreign trade. Yet Congress hesitates to pass such a measure, although no American interest could be injured in any way.

Another stated objection to the admission of "free ships" is that "the admission of foreign-built steamers would kill the art of shipbuilding in the United States." Well, as far as building for the foreign trade is concerned, it is dead now. It is some years since any steamers were built for trans-Atlantic trade, and the few built in the last decade were in many cases put under foreign flags and are now operated between European and American ports.

Holland, Norway, Sweden, Belgium, are countries with a small population and but little natural resources, yet owing to their free ship policy they have fleets of merchant steamers that trade in every quarter of the globe.

Up to 1849 England had navigation laws similar to those of the United States. In that year they were repealed, and with their passing England's shipping began to expand till to-day she is far and away the most important shipping nation in the world.

Germany took pattern by England and also passed a free-ship measure which is still in effect and her merchant marine began to expand, she has continued the policy of allowing German citizens to buy or build steamers in the cheapest market, granting German registration, to this day. In addition, all shipbuilding material is admitted free of duty into Germany.

This policy has placed her second among the shipping nations of the world, and it has aided the development of her shipyards, they have kept pace with the growth of the German tonnage and to-day vie with England in turning out the largest and fastest steamers afloat.

France is the one European country that stands out pre-eminently as a believer in bounties for shipbuilders and subsidies for tonnage. Her policy has been in effect for years, she pays enormous sums annually in aid of her merchant marine, yet it is a negligible factor as compared with England and Germany, and hardly compares with many of the smaller countries.

The freight rates on French ships are higher than on tonnage of countries not subsidized, and tonnage of other countries has no difficulty in competing with the French, even to the ports of France.

The policy of subsidy and bounty followed by France may induce the building of steamers, but it does nothing to advance trade and commerce.

For our foreign trade we need a merchant marine, and to secure it we should have "free ships." It is pointed out by Admiral Bowles that to move one-third of our present foreign commerce, it would require ten years to build the necessary steamers—and the Panama canal is to be opened in 1915, possibly in 1913 according to Col. Goethals. At the outside, less than four years from now steamers will be using this canal.

A free-ship bill is the solution of the American merchant marine. It can do no harm to any American interest. Our yards build no tonnage for the foreign trade, even if they could compete to-day, they could do no more than keep pace with the ever increasing demand for tonnage.

If it is necessary to subsidize to keep our shipyards going let it be for steamers of the highest class and of high speed—20 knots at least, steamers that will be of value in case of war, and that can deliver mails and passengers to South American ports in quicker time than is now possible. Such steamers will do something to stimulate travel and intercourse between the nations of South America and the United States.

The great lines of traffic are operated by steamers of moderate speed and low cost of operation, and until we can build steamers of such a type as cheaply as foreign builders, Americans should be allowed to buy foreign built steamers with the privilege of American registration to ply in foreign trade only. With the passage of such a bill, tonnage under the American flag would rapidly increase and our commerce correspondingly expand, and not the least important benefit to follow, will be that our battle fleet will have an ample supply of colliers and transports.

Chicago, Ill. CHARLES DUPEYET

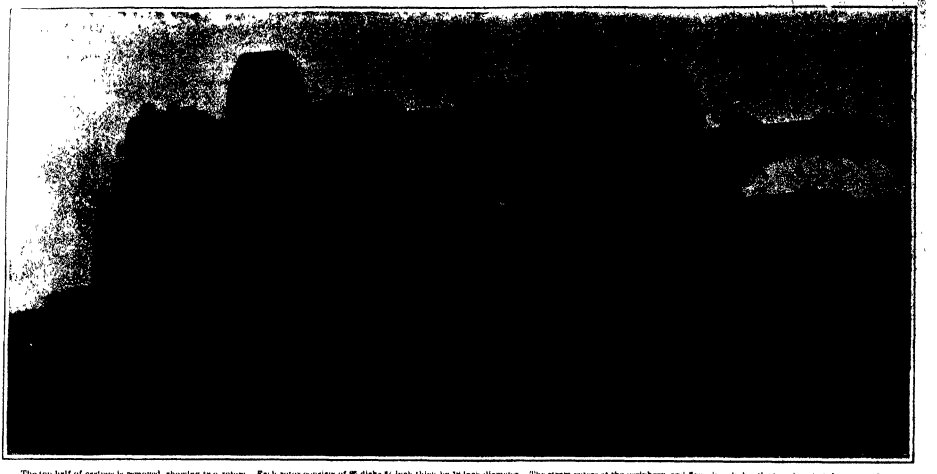
Oil as a Locomotive Fuel

THE advent of fuel oil has become an important factor in railway locomotion. It is estimated by the United States Geological Survey that from 20,000,000 to 23,000,000 tons of coal per annum are replaced by oil, and a large part of this is used by locomotives.

In this connection there is interest in a statement which will appear in the forthcoming petroleum report of the Geological Survey showing the extent to which oil is used as a locomotive fuel. The author of this report, David T. Day, computes the total length of railway lines operated during 1910 with petroleum as a fuel to be 30,776 miles, a mileage practically equivalent to that of two complete transcontinental lines stretching across the United States from ocean to ocean. The number of barrels of fuel oil used by the railroads (42 gallons per barrel) was 24,526,683. This includes 766,765 barrels used by the railroads as fuel other than in locomotives. The total number of miles run by oil burning engines during the year was 88,318,947. This would have carried one engine or train around the world approximately 3,530 times.

The advantages of oil as locomotive fuel over coal have been stated by Eugene McAuliffe as many. They include decreased cost of handling oil from cars to engines, with practically no loss by depreciation due to such handling; evaporation losses suffered by coal as not applying to oil; saving of time at terminals for engine cleaning and providing increased mileage per engine, the oil capacity of the tender being about 150 per cent of that of coal, freedom from physical failure of firemen in extreme hot weather, delivery of oil being unaffected by labor conditions, the coal situation necessitating in some instances heavy storage at great expense, greater cleanliness in handling all passenger trains, lack of smoke and immunity from right-of-way forest fires.

The expense of equipping the average locomotive to burn oil is about $800, and the cost of large steel storage tanks is about 25 cents per barrel but the necessary terminal facilities for handling oil cost 50 per cent less than the amount required to handle coal.



The top half of casings is removed, showing two rotors. Each rotor consists of 25 disks ⅛ inch thick by 18 inch diameter. The steam enters at the periphery, and flows in spiral paths to exhaust at the center of the disks. The driving turbine is to the left, the brake turbine to the right. Between them is a torsion spring. The steam inlets are on opposite sides on the two rotors; the driving rotor moving clockwise. The torsion of the spring is automatically shown by beams of light and mirrors and the horse-power is read off a scale. At 9,050 revolutions per minute, with 185 pounds at the throttle and free exhaust, this turbine develops 200 horse-power. It weighs two pounds per horse-power.

The Tesla turbine testing plant at the Edison Waterside Station, New York.

The Tesla Steam Turbine

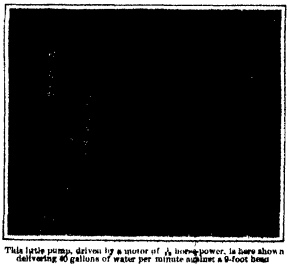
The Rotary Heat Motor Reduced to Its Simplest Terms

IT will interest the readers of the SCIENTIFIC AMERICAN to know that Nikola Tesla, whose reputation must, naturally, stand upon the contributions he made to electrical engineering when the art was yet in its comparative infancy, is by training and choice a mechanical engineer, with a strong leaning to that branch of it which is covered by the term "steam engineering." For several years past he has devoted much of his attention to improvements in thermo-dynamic conversion, and the result of his theories and practical experiments is to be found in an entirely new form of prime movers shown in operation at the Waterside station of the New York Edison Company, who kindly placed the facilities of their great plant at his disposal for carrying on experimental work.

By the courtesy of the inventor, we are enabled to publish the accompanying views, representing the testing plant at the Waterside station, which are the first photographs of this interesting motor that have yet been made public.

The basic principle which determined Tesla's investigations was the well-known fact that when a fluid (steam, gas or water) is used as a vehicle of energy, the highest possible economy can be obtained only when the changes in velocity and direction of the movement of the fluid are made as gradual and easy as possible. In the present forms of turbines in which the energy is transmitted by pressure, reaction or impact, as in the De Laval, Parsons, and Curtiss types, more or less sudden changes both of speed and direction are involved, with consequent shocks, vibration and destructive eddies. Furthermore, the introduction of pistons, blades, buckets, and intercepting devices of this general class, into the path of the fluid involves much delicate and difficult mechanical construction which adds greatly to the cost both of production and maintenance.

The desiderata in an ideal turbine group themselves under the heads of the theoretical and the mechanical. The theoretically perfect turbine would be one in which the fluid was so controlled from the inlet to the exhaust that its energy was delivered to the driving shaft with the least possible losses due to the mechanical means employed. The mechanically perfect turbine would be one which combined simplicity and cheapness of construction, durability, ease and rapidity of repairs, and a small ratio of weight and space occupied to the power delivered on the shaft. Mr. Tesla maintains that in the turbine which forms the subject of this article, he has carried the steam and gas motor a long step forward toward the maximum attainable efficiency, both theoretical and mechanical. That these claims are well founded is shown by the fact that in the plant at the Edison station, he is securing an output of 200 horse-power from a single-stage steam turbine with atmospheric exhaust, weighing less than 2 pounds per horse-power, which is contained within a space measuring 2 feet by 3 feet, by 2 feet in height, and which accomplishes these results with a thermal fall of only 130 B T U, that is, about one-third of the total drop available. Furthermore, considered from the mechanical standpoint, the turbine is astonishingly simple and economical in construction, and by the very nature of its construction, should prove to possess such a durability and freedom from wear and breakdown as to place it, in these respects, far in advance of any type of steam or gas motor of the present day.



This little pump, driven by a motor of ¼ horse-power, is here shown delivering 40 gallons of water per minute against a 9-foot head.

The turbine used as a pump.



This view shows one-sixteenth inch pressure pipe, with the steam throttle shown, and below it the reversing valve and the compact turbine. Note the many speed nuts in the tests.

A 200-horse-power high-pressure turbine.

Briefly stated, Tesla's steam motor consists of a set of flat steel disks mounted on a shaft and rotating within a casing, the steam entering with high velocity at the periphery of the disks, flowing between them in free spiral paths, and finally escaping through exhaust ports at their center. Instead of developing the energy of the steam by pressure, reaction, or impact, on a series of blades or vanes, Tesla depends upon the fluid properties of adhesion and viscosity—the attraction of the steam to the faces of the disks and the resistance of its particles to molecular separation combining in transmitting the velocity energy of the motive fluid to the plates and the shaft.

By reference to the accompanying photographs and line drawings, it will be seen that the turbine has a rotor *A* which in the present case consists of 25 flat steel disks, one thirty-second of an inch in thickness, of hardened and carefully tempered steel. The rotor as assembled is 3¼ inches wide on the face, by 18 inches in diameter, and when the turbine is running at its maximum working velocity, the material is never under a tensile stress exceeding 50,000 pounds per square inch. The rotor is mounted in a casing *D*, which is provided with two inlet nozzles, *S* for use in running direct and *S'* for reversing. Openings *C* are cut out at the central portion of the disks and these communicate directly with exhaust ports formed in the side of the casing.

In operation, the steam, or gas, as the case may be, is directed on the periphery of the disks through the nozzle *S'* (which may be diverging, straight or converging), where more or less of its expansive energy is converted into velocity energy. When the machine is at rest, the radial and tangential forces due to the pressure and velocity of the steam cause it to travel in a rather short curved path toward the central exhaust opening, as indicated by the full black line in the accompanying diagram; but as the disks commence to rotate and their speed increases, the steam travels in spiral paths the length of which increases until, at

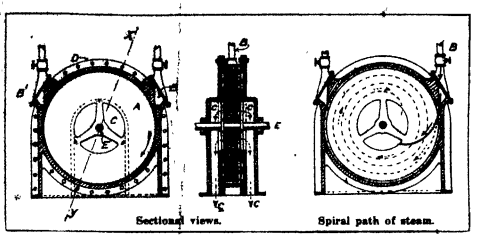
In the case of the present turbine, the particles of the fluid complete a number of turns around the shaft before reaching the exhaust, covering in the meantime a lineal path some 12 to 16 feet in length. During its progress from inlet to exhaust, the velocity and pressure of the steam are reduced until it leaves the exhaust at 1 or 2 pounds gage pressure.

The resistance to the passage of the steam or gas between adjoining plates is approximately proportional to the square of the relative speed, which is at a maximum toward the center of the disks and is equal to the tangential velocity of the steam. Hence the resistance to radial escape is very great, being furthermore enhanced by the centrifugal forces acting obliquely. One of the most destructive enemies in a perfected turbine is that of irreversibility, and we are not familiar with the many and frequently cumbersome means which have been employed to secure this end, but with the knowledge that this turbine is admirably adapted for reversing, since this effect can be secured by merely closing the right-hand valve and opening that on the left.

It is evident that the principles of this turbine are equally applicable, by slight modifications of design, for its use as a pump, and we present a photograph of a demonstration model which is in operation in Mr. Tesla's office. This little pump, driven by an electric motor of 1/12 horse-power, delivers 40 gallons per minute against a head of 9 feet. The discharge pipe leads up to a horizontal tube provided with a wire mesh for screening the water and checking the eddies. The water falls through a slot in the bottom of this tube and after passing below a baffle plate flows in a steady stream about ⅝ inch thick by 18 inches in width, to a trough from which it returns to the pump. Pumps of this character show an efficiency favorably comparing with that of centrifugal pumps and they have the advantage that great heads are obtainable economically in a single stage. The runner is mounted in a two-part volute casing and except for the fact that the place of the buckets, vanes, etc., of the ordinary centrifugal pump is taken by a set of disks, the construction is generally similar to that of pumps of the standard kind.

In conclusion, it should be noted that although the experimental plant at the Waterside station develops 200 horse-power with 125 pounds at the supply pipe and free exhaust, it could show an output of 300 horse-power with the full pressure of the Edison supply circuit. Furthermore, Mr. Tesla states that if it were compounded and the exhaust were led to a low pressure unit, carrying about three times the number of disks contained in the high pressure element, with connection to a condenser affording 28½ to 29 inches of vacuum, the results obtained in the present high-pressure machine indicate that the compound unit would give an output of 600 horse-power, without great increase of dimensions. This estimate is conservative.

The testing plant consists of two identical turbines connected by a carefully calibrated torsion spring, the machine to the left being the driving element, the other the brake. In the brake element, the steam is delivered to the blades in a direction opposite to that of the rotation of the disks. Fastened to the shaft of the brake turbine is a hollow pulley provided with two diametrically opposite narrow slots, and an incandescent lamp placed inside close to the rim. As the pulley rotates, two flashes of light pass out of the same, and by means of reflecting mirrors and lenses, they are carried around the plant and fall upon two rotating glass mirrors placed back to back on the shaft of the driving turbine so that the center line of the silver coatings coincides with the axis of the shaft. The mirrors are so set that when there is no torsion on the spring, the light beams produce a luminous spot stationary at the zero of the scale. But as soon as load is put on, the brake is deflected through an angle which indicates directly the torsion. The scale and spring are so proportioned and adjusted that the horse-power can be read directly from the deflections noted. The indications of this device are very accurate and have shown that when the turbine is running at 9,000 revolutions under an inlet pressure of 125 pounds to the square inch, and with free exhaust, 200 brake horse-power are developed. The consumption under these conditions of maximum output is 38 pounds of saturated steam per horse-power per hour—a very high efficiency when we consider that the heat-drop, measured by thermometers, is only 130 B T U, and that the energy transformation is effected in one stage. Since about three times this number of heat units are available in a modern plant with superheat and high vacuum, the above means a consumption of less than 12 pounds per horse-power hour in such turbines adapted to take up the full drop. Under certain conditions, however, very high thermal efficiencies have been obtained which demonstrate that in large machines based on this principle, in which a very small slip can be secured, the steam consumption will be much lower and should, Mr. Tesla states, approximate the theoretical minimum, thus resulting in nearly frictionless turbine transmitting almost the entire expansive energy of the steam to the shaft.

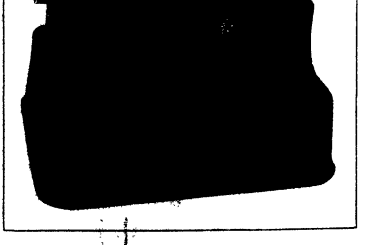


Sectional views. Spiral path of steam.

Details of turbine.

Some Striking Coal Facts

LAST year the United States mined 501,596,378 short tons of coal or nearly two-fifths of the year's total production for the world. This coal would load a train stretching back and forth across the United States from the Atlantic to the Pacific 33 times—a train approximately 100,000 miles long. Eleven years ago the United States for the first time surpassed Great Britain with a production of 253,741,192 tons, only a little more than half of last year's output. The mere increase of the coal output of the United States for 1910 over that of 1909—40,781,762 tons—was greater than the total production of any foreign country except Great Britain, Germany, Austria, Hungary, or France.



This turbine, whose rotor contains simply a set of flat disks 18 inches in diameter, develops 200 brake horse-power on test.

Turbine with upper half of casing removed.

This increase alone was one and one-fifth times as great as the entire production of the United States in 1870, surpassing only Great Britain and Germany, either of the states of Pennsylvania or West Virginia produced in 1910 more coal than any foreign country. For the past seven or eight 10-year periods the coal production for each decade has been about equal to the entire amount of coal previously mined in the United States. Thus in the 10 years between 1885 and 1895 the production was 1,585,098,841 tons, while the entire amount of coal mined prior to 1895 was only 1,559,080,473 tons. In the 10 years between 1895 and 1905 the production was 2,822,462,746 tons, while all the coal which had been mined prior to 1895 was 3,138,174,119 tons.

Incredible as it may seem, at the present rate of increase the ten year period between 1905 and 1915 will show a production greater than all the coal mined in the United States prior to 1905. In 1850 the per capita production of coal was a little over one-fourth of a ton. In 1870 the per capita production had increased to nearly one ton, in 1890 it was 2½ tons, in 1900 it was 3½ tons, and in 1910 with the population of 91,972,266 the production was nearly 5½ tons for each person.

Last year 725,030 men mined coal in the United States. The great coal production record of 1910 was made in spite of a series of labor strikes participated in by 215,640 men. The loss in wages alone amounted to nearly $20,000,000.

The quantity of coal used for making coke in the United States for metallurgical purposes was 52,187,450 tons. This is additional to by-product coke produced in gas manufacture.

The total production of coal in the United States at the close of 1910 was 8,243,351,259 short tons. This plus the estimated loss incident to mining makes a total exhaustion of 13,395,000,000 tons. The United States Geological Survey estimates the original supply of coal in the ground in the United States, exclusive of Alaska, at 3,076,204,000,000 tons. This original supply less the exhaustion at the close of 1910 leaves an apparent supply still available of 3,062,808,972,000 tons, or 99.6 per cent of the original supply. In other words, in all the time since coal mining began in the United States the draft upon the original supply including loss in mining, has amounted to less than one half of one per cent. At the present rate of production of approximately half a billion tons a year the coal reserve of the United States would therefore last 6,000 years. At the present rate of increase in production, however, these three thousand billion tons of coal in the ground would last only a few generations.

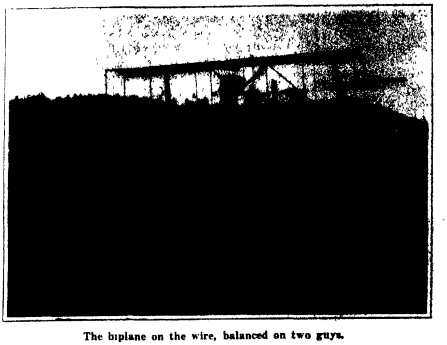
Foreign Students in America

ADDRESSING the House of Representatives on the many new activities of the United States diplomatic service, Representative Foster, of Vermont, late chairman of the House Foreign Affairs Committee, recently called attention to the effort made by our diplomatic and consular representatives to advertise the United States as an educational center, an undertaking that has been fruitful of results.

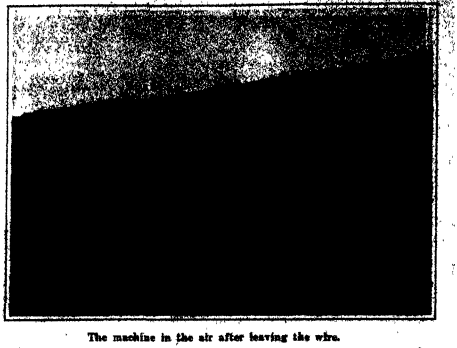
One of the outcomes of this program was the formation in Buenos Aires two years ago of a United States University Club, which has been the means of sending at least 20 young Argentinians to this country to be educated. Under the auspices of this club lectures are given on university life in the United States, illustrated with a large number of appropriate stereopticon views. Negotiations are now under way for an interchange of schoolboys between the Boston High School of Commerce and the preparatory department of the University of La Plata. There are now at least 400 Latin Americans studying in the United States, and the number is steadily increasing.

Through the efforts of our ambassador at Constantinople supported by the State Department, Columbia University has voted to receive, free of all tuition charges, three students annually from the Ottoman Empire for the next ten years, to pursue courses of study in any of the departments of the university. These students are to be selected by the Ottoman government, with the advice and approval of the ambassador at Constantinople.

The education of Chinese students in America, a matter in which the United States government has always taken a kindly interest, is assuming ever larger proportions. These students now number between 800 and 900. Half of these are "government students" supported by the different Chinese provinces and by the remitted portion of the Boxer indemnity fund. To insure that the indemnity students coming to the United States should not start with a serious handicap, but be fully prepared to enter the American colleges, an academy has been established in Peking by the Chinese government where these students receive preliminary instructions under American teachers.



The biplane on the wire, balanced on two guys.



The machine in the air after leaving the wire.

Launching an Aeroplane from a Wire

The New Curtiss Naval Flying Machine

By far the most serious problem which confronts the Navy Department in its effort to utilize aeroplanes is the difficulty of providing a suitable launching and alighting gear. Every one knows nowadays that before it can really fly, an aeroplane must be in motion; that, like any soaring bird, it must make an initial run in order to get up speed. Alighting on land has always presented its difficulties. Indeed, it may be safely said that the landing chassis as we know it is capable of much improvement. How much more difficult must it be to land on water?

The first experiments which were made in our navy with the aeroplane involved the use of a rather extensive platform on the forecastle of the scout cruiser "Birmingham." Down this platform, at a fairly steep angle, Ely in a Curtiss biplane, ran on November 8th of last year, and for the first time in history succeeded in launching a flying machine from the deck of a warship. Two months later he succeeded in starting from and alighting upon the "Pennsylvania."

Remarkable as this achievement was, it is obvious that warships cannot carry about with them platforms of such size. In action, every piece of unnecessary apparatus, every incumbrance, is simply tossed overboard. The platform unquestionably would have to go with the rest, if the ship is to be fought at all.

Mr. Glenn H. Curtiss seems to have succeeded in overcoming these difficulties, by adopting the hydroplane construction. He has shown that it is possible both to start from the water and to alight upon it with comparative ease and safety. In a word, he devised a type of flying machine peculiarly adapted to the needs of the navy.

The problem of providing a suitable launching gear, which can be used when the water is too rough for the hydroplane float, seems now to have been solved with equal felicity. At Hammondsport, on Lake Keuka, Curtiss has been making experiments which show that it is possible to launch a hydro-aeroplane from a wire cable. Perhaps the most successful trials were made by Lieut. Ellison. According to Mr. Curtiss, it would only be necessary to stretch one wire from the boat deck of a battleship down to the bow. On this cable the hydroplane glides down, being kept from falling by two auxiliary wires which support the wings until the machine gets up sufficient headway to keep its own balance by means of the ailerons or other control.

Such a launching gear does not interfere in any way with the guns or armament and can be stowed away after it has served its purpose in a very short time.

The experiment shows that whenever the sea is too rough to permit the hydroplane to rise from the waves, it can always take the air by means of the cable.

Submarine Cables and Longitude Determination

The Improvements Devised by Colonel Bourgeois

By Jacques Boyer

An accurate comparison between two astronomical clocks, situated at a great distance from each other, can be made by overland telegraphy, by means of which the time signals given by both clocks are recorded, side by side, on an electric chronograph at each station. The ordinary electric chronograph is provided with two pens, or writing points, operated by electro-magnets, so that each pen makes a distinctive mark on the same uniformly rotating cylinder or moving strip of paper, when the circuit of its electro-magnet is made or broken. Usually one pen marks the time by the local clock, while the other records signals made by the observer, on the passage of a star over the wires of the transit instrument or the occurrence of any other event. For the determination of longitude, the electro-magnet of the second pen is connected with the clock at the distant station.

In order to determine the difference of longitude between two stations by this method, it is necessary to transmit from each station to the other currents

(Continued on page 306.)



The double chronograph.

Apparatus for connecting a turntable by cable.

THE EMPLOYMENT OF SUBMARINE CABLES IN THE DETERMINATION OF LONGITUDE

Current Astronomical Events

Brooks's Comet; The Harvest Moon

Brooks's Comet

How to Find It Without the Aid of a Telescope

By E. A. Mitchell, Professor of Astronomy at Columbia University

THERE is hardly a person anywhere who is not interested in a comet, and at the present time one is visible each night without the aid of a telescope. Moreover, it is not at the limit of visibility to the naked eye, but one which can be readily seen by anyone who cares to spare a few minutes watching for it.

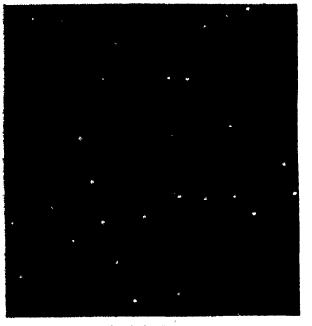
The comet known to astronomers as Brooks's, or Comet 1911c, was discovered on the night of July 20th by the famous comet-seeker at Geneva, N. Y. When discovered, it appeared as a faint hairy star, without a tail, entirely unlike the popular idea of a comet. Observations on this and the following few nights gave astronomers the opportunity of calculating its path with respect to the sun, and in relation to the earth. These calculations furnish an ephemeris which gives the position in the sky where the comet may be found. Such a calculation is a laborious piece of work, which must be done with great precision, and with care that no mistakes are made in the additions and subtractions. Ordinarily when a comet is discovered a parabolic orbit is first computed, for this calculation is the easiest and presents the fewest difficulties. Such an orbit is quite an impossible thing in astronomy, but on account of the simplicity, it is adopted because it gives the position of the comet near enough for all practical purposes.

If the comet is an interesting one, or if it is the return of one formerly discovered, then the more difficult elliptical elements are calculated. In the case of Halley's comet, this was an exceptionally difficult undertaking, for the "perturbations" or attraction of the various planets led to serious complications.

Several sets of calculations have been made for Brooks's comet, one of the most reliable being that of F. E. Seagrave of Providence, R. I. The ephemeris for the end of September and beginning of October follows:

Date.	Right Ascension. h	m	s.	Declination. deg.	m.	s.
September 21st	15	31	15	+ 55	0	39
September 25th	14	51	17	49	21	7
September 29th	14	17	44	44	58	56
October 3rd	13	49	52	40	6	42
October 7th	13	26	46	34	51	0

The amateur with his small telescope and circles can readily find the comet from this table. Right ascension and declination in the sky correspond to longitude and latitude on the earth. A ship at sea is located by knowing its longitude and latitude, or New York city is found by knowing that its longitude is 74 degrees west, and its latitude 40 degrees 48 minutes north. The stars are kept track of by means of their right ascensions and declinations. As we can locate a certain direction from New York, so we can locate the comet from its position with respect to the stars without paying attention at all to the figures which give the right ascensions and declinations.



The path of the Brooks comet.

On September 2nd a photograph by Prof. Barnard exhibited a tail eight degrees in length, which corresponded in extent to 10,000,000 miles. At the same time the head measured 500,000 miles across. The comet was closest to the earth on September 17th, when it was readily visible as a fourth magnitude star. It was then forty-eight million miles away from us. Steadily the comet is speeding toward the sun, the great central luminary which exerts its attractive influence on all bodies of the solar system. On October 27th, the comet will be at perihelion, when it will be 45,000,000 miles distant from the sun, which is as close as it will approach that body. At the middle of September, the comet was a circumpolar object at 57 degrees north declination. Its motion has been southwest more than a degree each day.

On September 30th, the comet will be as bright as the fifth magnitude and can be quite easily found near the end of the handle of the "Big Dipper." The handle takes a crook in it at the well-known double star Mizar. Follow from Mizar to the end of the handle, and in a straight line five degrees farther on, the comet may be seen, or, in other words, the comet will be about half way between the end of the handle of the "Dipper" and the third magnitude star Gamma Bootis. The comet will set about 10 o'clock. One should look for it immediately after sunset (though the moon will interfere somewhat) before the comet gets too near the horizon. The comet's rapid motion makes it set earlier each night, so that on October 7th it sets at 9 P. M. It will soon set as early as the sun when it will become invisible to be seen later in the month before sunrise.

Though the head of the comet has been quite bright, its tail has been difficult to see in the telescope because it is so faint. It needed a long exposure to photograph the tail.

The world is still waiting for a brilliant comet to appear, one which may be seen in the sky in spite of the electric lights of the city and without special diagrams, one which will rival the great comet of 1882.

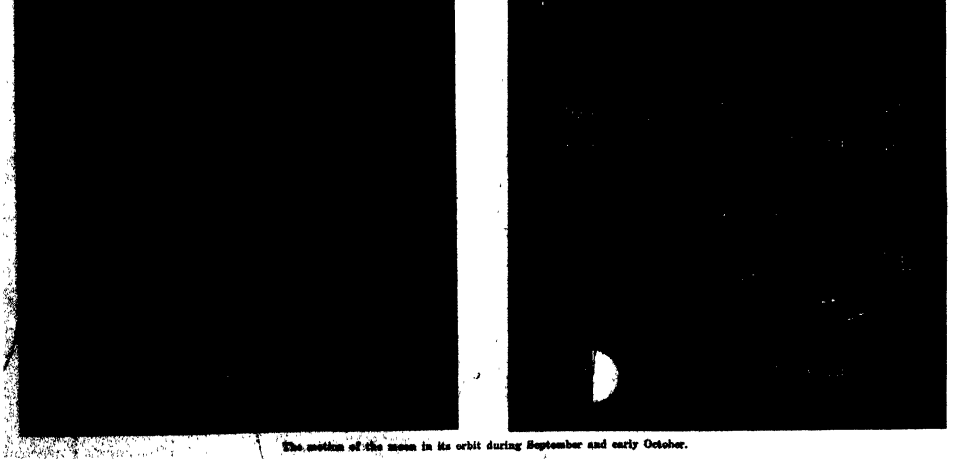
The Harvest Moon

By Frederic R. Honey, Professor of Astronomy at Trinity College

THE term "harvest moon," originating in England, where the brilliant moonlight of several consecutive evenings aided the harvesting of crops, is the popular expression for the moon at its full in the month of September in northern latitudes. This phenomenon of early moon-rise is dependent upon the degree of retardation of the moon's rising, as affected by difference in latitude. As conditions in England are especially favorable, full moon-rise at harvest time therefore occurs earlier than in the lower latitudes of this country. Following out this law of retardation, it is a matter of course to look for a yet earlier rising of the "harvest moon" in the far north of the Scandinavian peninsula; and an extremely opposite condition in the corresponding latitudes of the Southern hemisphere, where the "harvest moon" (if it were possible to use the term in this region) would occur about the time of the vernal instead of the autumnal equinox.

Variations in the retardation of the moon's rising (a retardation which averages about 51 minutes daily) are due to complex conditions. If the earth's axis were perpendicular to the plane of the ecliptic, and if the earth and moon revolved in circular orbits at uniform velocities around their respective centers of motion in that plane, the retardation would obviously be constant. But the earth's axis is inclined at an

(Continued on page 301.)



The motion of the moon in its orbit during September and early October.

The Laboratory

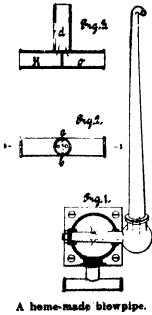
Some Suggestions for Home Experiment

The Amateur's Oxy-hydrogen Blowpipe

By A. J. Jarman

So many interesting experiments may be performed with the oxy-hydrogen blowpipe that it is almost an essential of the amateur's laboratory. With it not only may any of the metals (platinum and iridium not excepted) be fused, but earthy bodies as well may be combined with various metallic oxides. The blowpipe illustrated herewith was designed by the writer, and used for many years. The construction is very simple. Procure a swivel joint, such as is illustrated in Fig. 1. If a joint of that exact type cannot readily be found, the amateur may devise one from the fittings of a gas light bracket. This joint should be firmly secured to a base of hard wood, such as mahogany. An ordinary brass blowpipe, of the type used in the mouth, should be secured to the swivel joint, as indicated at *a* in Fig. 1. The best way to do this is to cut off the lower end of the blowpipe with a triangular file, twist a piece of copper wire around the end, and press it into the joint, and then secure it by soldering it with soft solder. The joint should be air-tight. The other part of the swivel joint should be fitted with a device such as illustrated in Figs. 2 and 3. It consists of a piece of brass or copper pipe, of ⅝-inch outside diameter. With a hack-saw make a cut in the pipe at the middle, as indicated at *b, c*, Fig. 2. Insert a small strip of brass or tin plate in this cut and solder it firmly in place, making sure that the joint is air-tight all around, so that the pipe is divided into two separate compartments. Drill two small holes in the tube, one at each side of the tin partition. Then solder a nipple *d* to the brass tube, so that it fits over the holes just referred to. In every case the soldering should be so done as to prevent leakage of gas or air at the joints. The nipple *d* should be screwed into the swivel joint, as indicated in Fig. 1. The two sections of the pipe may be connected by rubber tubing to the oxygen and hydrogen sources of supply. In order that the rubber tubing may be firmly held to the brass pipe, it is best to solder a ring of brass wire to the edge, forming a flange.

The hydrogen (carbureted) may be obtained from a gas bracket after removing the tip or burner. The other side of the tube, marked *o* in Fig. 3, should be connected to the oxygen supply, which may either be a cylinder of compressed oxygen, a gas holder, or a gas bag. In use, first turn on the hydrogen or the coal gas and light it at the nozzle of the blowpipe. Then gradually turn on the oxygen. The two gases will commingle in the nipple *d*, and in the swivel joint, and the presence of the oxygen in the gas will immediately be attended by a reduction of the length of the flame. Turn on the oxygen slowly until a very brilliant bluish green flame protrudes from the blowpipe nozzle. This will indicate the hottest flame obtainable from the mixture. In case of an excess of oxygen, the mixture will ignite within the blowpipe, producing an explosion, which, however, will not be of serious proportions. A piece of battery carbon forms a very good fusion plate upon which the material to be treated may be placed. Slate dust, graphite, glass powder, and many of the metallic oxides, may be fused with this blowpipe. A small quantity of powdered borax aids the fusion of the oxides. Metals of any kind may be welded together, even platinum. The blowpipe may be used to produce a brilliant lime-light by letting the flame impinge upon a stick of common lime, mounted on the end of an iron wire rod, and shaped with a file with a hole at the center of the cut drilled with a brad awl. A light of from 200 to 400 candle-power can thus be produced, with which excellent photographs may be taken at night.



A home-made blowpipe.

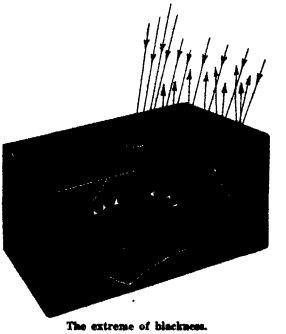
Experiments can also be made with blocks of magnesia, zinc oxide, oxide of zirconium and compounds of these and other infusible oxides, all of which will give a brilliant light of varying color generally without fusing. Dissimilar metals can be joined in the form of wire without special fluxes. Should a flux be required, borax answers the purpose very well, or boracic acid. The fusing together of different metallic oxides by the aid of boracic acid flux will often produce excellent imitations of precious stones.

An excellent illustration of the explosive properties of a mixture of oxy-hydrogen gas can be shown by blowing soap bubbles with the blowpipe, and allowing the bubble to float in the air; then apply a lighted taper. The report upon ignition will be deafening. A soap bubble blown at the tip of the blowpipe, and the gas supply cut off will act in the same way, but it is better if it be allowed to float in the air.

The Standard Black

By A. L. Hodges

The question often arises, What is pure black? Teachers of physics say that black is an absence of all color—that is, no matter what light falls on a pure black substance none will be reflected, all being absorbed. There is no such substance known to man which will do this thing but, as usual, ingenuity has overcome this disadvantage. The standard of blackness and, than which none can be blacker, is simply a hole in a black box. The physical reasons for this are easy to see. The only condition necessary is that a minimum number of rays of light shall be reflected from the standard of blackness. To show the advantage of the hole we will contrast the rays reflected from the black face of the box with the number coming out of the hole. Let a ray beam of light strike the face and hole normally or obliquely. The face at once shows itself lighter than the hole for this reason: The rays striking the face are diffusely reflected in every imaginable direction and at every imaginable angle, consequently an eye in front of the face will receive a certain number of these diffusely reflected beams. But now consider the rays that go through the hole and that strike the back of the box (also painted black, and of a rough surface, as is the face). These will also be reflected in every imaginable direction and *for that reason* the majority of them will not come out of the hole but be caught on the inside of the face being either absorbed or reflected again. So if a fewer number of rays come out the appearance will be the more black to the eye, as the eye only "sees" when a ray of light enters it. Illustrations of this principle are common. If one looks into an open window of a house on a very bright day, even, the window looks simply like a black hole—the light getting in is not reflected back again in near the amount of entering, even though the inside wall be of the same color as the outside wall.



The extreme of blackness.

Air Apparatus for Amateurs

By John D. Adams

Compressed air has such a wide application to experimental work and in so many of the arts that it may not be amiss to point out the possibilities of ordinary bicycle supplies in this line of work.

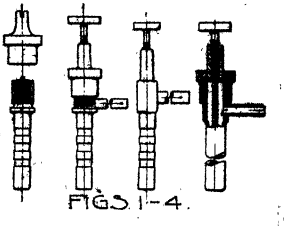
Considering its cost, lightness, and simplicity, the ordinary ten-cent bicycle pump is a remarkable piece of apparatus. If we desire a moderate supply of compressed air to operate, for example, an air brush or a torch—it is only necessary to solder a bicycle valve to a suitable tank and connect our pump. But, you say, how are we to get the air out of the tank? In Figs. 1 to 4 is shown the method of converting a bicycle valve into a needle valve—and an excellent needle valve, too, because when it comes to holding air it is hard to beat a bicycle valve. It will retain air for months. The valve in Fig. 1 is drilled at the base of the threaded portion, and is provided with a small brass tube, fitted into the drilled hole and securely soldered. The cap is drilled through the top and threaded for a screw, which, when screwed far enough down, pushes the little valve stem down and thus lets the air escape. A very small leakage may occur around the rubber gasket in the cap, but this is negligible, as it occurs only when the air is being drawn. If cutting threads is an inconvenient operation, procure an ordinary nipple and spoke. File off the top of the cap, drill a hole in its top, fit on the nipple and secure it with solder. The resulting cap will then be as in Fig. 2. Cut off the threaded end of the spoke and solder on a round cap, so as to form a suitable screw.

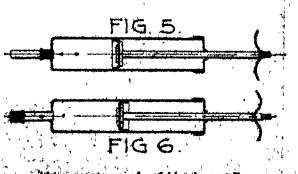
The somewhat neater valve shown in Fig. 3 may be made by filing off all the threaded portion of the original valve and discarding the cap entirely. The small side outlet tube is provided as before, and the nipple is fitted and soldered directly into the top. The regulation of the air supply is very sensitive.

If three ordinary ten-cent bicycle pumps are arranged so as to be operated from a crank shaft with a fly wheel, we obtain a small triplex pump of good capacity and very uniform delivery. In such arrangements it will usually be found more satisfactory to make the delivery from the lower end instead of through the hollow piston rod, in which event the latter must be soldered up and the lower end provided with a suitable outlet tube. Where it is not practicable to have the valve attached to the air tank, solder it to the lower end of the pump, as in Fig. 5.

Fig. 6 shows the ordinary bicycle pump changed into a vacuum pump. The cup leather is reversed, the piston rod is closed, and a valve is soldered to the lower end in the position illustrated. It is hardly necessary to remark that such a pump will not produce a high vacuum, but it will compare very favorably with the best piston pumps, and will be found useful in many experiments requiring a greatly reduced air pressure.

Sometimes tin cans, such as groceries come in,





Air apparatus made of bicycle supplies.

will serve as air tanks, but if the pressure is rather high choose one having a length of two or more diameters and brace it by running some straight pieces of wood through and projecting beyond at the ends.

The Inventor's Department

Simple Patent Law; Patent Office News: Inventions New and Interesting

Mechanical Advertising Novelties

Of the many ingenious schemes employed in advertising, none have proved more effective than the various mechanical devices which various inventors have turned out from time to time. The public in general loves a mystery, and a device which apparently contravenes some general law of nature is sure to receive much attention. In Fig. 1 is shown an apparatus, recently patented, which has been quite successful as an advertising novelty. It consists of a bottle suspended in an inclined position and from its mouth there pours a constant stream of liquid into a tank. As there is no visible means for replenishing the liquid in the bottle, one would naturally expect it soon to become empty, but the level of the liquid in the bottle remains the same. Nature's laws, however, have not been upset, for in the center of the stream is a glass tube of the same color as the liquid and, hence, invisible. The lower end of this tube is connected with a pump and the upper end extends up into the bottle so that the pump is constantly withdrawing liquid from the tank and forcing it up into the bottle, whence it pours out around the glass tube, thus rendering it invisible. So perfect is the illusion, that no hint can be gained from a working device as to the secret of its operation.

A clock, keeping excellent time and consisting of a plate of glass on which is painted a dial, a bolt passing through the center of the dial and forming an axis for hands, with no apparent place for a clock movement, will always attract much notice. Recently an ingenious jeweler in a West Virginia lumber town constructed one, using a pane of glass, and wood for the hands. Many a lumber jack spent hours conjecturing how it worked. It made no difference in which position the hands were placed, they would promptly revert to their proper position. The wooden hands were carefully covered with tinfoil, so as to conceal the watch movements inclosed therein. The balancing of the hands was accomplished by an ingenious system of shifting weights. A number of clocks of this type have been patented, one of the cleverest being shown in Fig. 2. The enlargements in the hands house the watch movements and the shifting counterweights.

Fig. 3 shows a clever apparatus for attracting attention. All that the spectator sees is a flat-topped box on which a large ball rolls round and round but never falls off. The force moving this sphere is invisible. The sphere is but a thin shell, and inside this shell is a small metallic ball which is free to move about the inner surface of the large sphere. Inside the box is a magnet which is rotated by a small motor. As the small ball endeavors to follow the magnet, it causes the large sphere to roll about the box lid.

For calling attention to the excellence of a certain brand of soap, the device shown in Fig. 4 was designed. This shows a very grimy figure descending from a chimney into a bath, from which he emerges clean and white. The two figures, however, are on opposite sides of belts which are driven by a hidden motor.

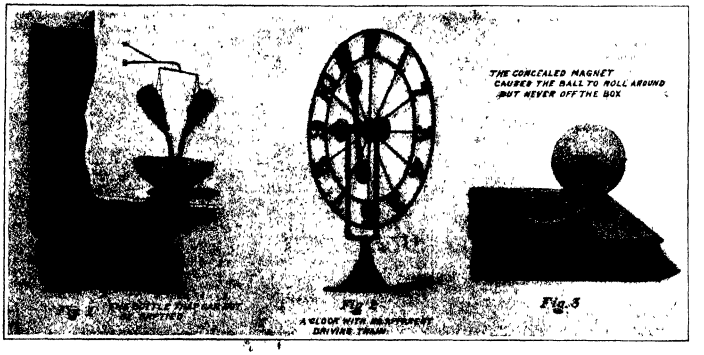
Most people imagine that the wooden Indian has a monopoly of the tobacco sign business, but he has a competitor in the dummy which ostensibly smokes a cigar. The cigar, however, is likewise a dummy and the smoke comes from a concealed pot of burning tobacco and is intermittently expelled from the lips of the dummy by concealed bellows. One of the most elaborate of these signs, which was recently patented, appears in Fig. 5. This is a hollow crescent figure, whose convex face is studded with incandescent lights, and bulbs are also arranged in the eyeholes and at the outer end of the cigar, held in the mouth of the figure. At the back of the figure is a box containing a small motor which operates mechanism for intermittently turning on and off the lights, and simultaneously with the turning on of the lights, to blow smoke out through the mouth of the figure.

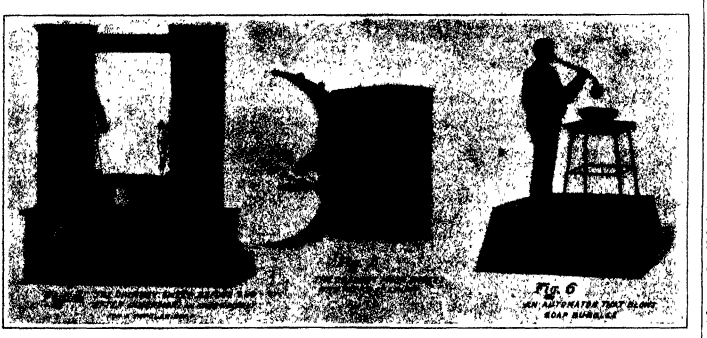
The blowing of soap bubbles is an occupation usually accorded to children, but an automaton for doing this has been patented (see Fig. 6). This figure dips his pipe in a bowl of soap suds, then raises his arm and at the same time a current of air is turned on for blowing the bubble. Then the air is cut off and the fan, which is held in the other hand, is waved and the bubble is blown off into the air. The bellows and the mechanism for working the various levers and the valve are located in the box on which the automaton stands.

The combination of a flower and butterfly (Fig. 8), is designed for the display of precious stones. By means of a clock-work mechanism, a cavity in the flower is alternately opened and closed and at the same time the wings of the butterfly and the petals of the flower are moved.

Nothing is quite so comforting to a hungry man on a cold day as the steaming dishes of food displayed in the windows of restaurants. Many a dyspeptic has come to grief when a steaming dish of corned beef and cabbage has been brought to his attention in this manner. A close examination of the dish would have disclosed a cleverly concealed steam pipe, running from some distant boiler and discharging through the bottom of the dish like the coffee cup shown in Fig. 7. Fig. 9 shows how this idea has been utilized for displaying effervescent wines. The stem of the wine glass is hollow and in the lower end is placed a porous plug, through which air is forced by a concealed pump. The pressure must be small in order that the air may rise in minute globules, thus imitating sparkling champagne. A concealed reservoir is also connected with the hollow stem so as to keep the liquid in the glass at a constant level, for a considerable part of the liquid will be lost in evaporation.

The advertising value of novelties of this kind is unquestioned and one is surprised, in looking for patents on this art, to find that the number is so small. Their







MECHANICAL ADVERTISING NOVELTIES

cost of production is generally so small, compared with the huge and elaborate signs now in use, that it would seem that inventors would find this a profitable field of endeavor

A Fireman's Smoke Protector

By Herbert T. Wade

IT is a popular fallacy that a fireman can be trained to endure almost any degree of smoke, thanks to the frequent use in the daily press of such terms as "smoke eaters" Beyond certain limits even the fireman is unable to withstand smoke, and it interferes greatly with his fighting fires at close range, especially in cellars Consequently, for many years there has been a demand for a practical smoke helmet or other device that would supply fresh air or oxygen to the fireman at work in an atmosphere impossible to breathe

Though they are used extensively in Europe and supplied to a number of American fire departments, such devices have never found wide favor in the United States, where they are regarded by many firemen as cumbersome and of limited utility Nevertheless, American firemen have been anxious to find suitable apparatus of this nature, and the investigations of mine rescue experts with such appliances have been observed with interest

The fireman demands a light weight device that shall be simple and reliable, ready at a moment's notice, yet easy to adjust and manipulate Under conditions where a line of hose may be used, this has been secured in a recent invention by James D Halloran of the New York fire department, which tested in actual service at a fire on September 19th, has been found to work with great success It consists of an auxiliary line of hose connecting with the outside air, through which pure air is drawn by the passage of the water through the nozzle of the main line of hose, and distributed by means of tubes connecting with a rubber piece covering the nose and mouth of the fireman like the nose guard of the football player The device involves a cylindrical brass piece or collar, which is screwed on the end of an ordinary control nozzle, such as is found in the equipment of any hose wagon. To this is attached a brass pipe about three feet in length which opens on the main bore, through which the stream passes, and connects with the air supply hose already mentioned. From this brass pipe are taken three flexible pipes which terminate in the rubber face pieces held by the teeth

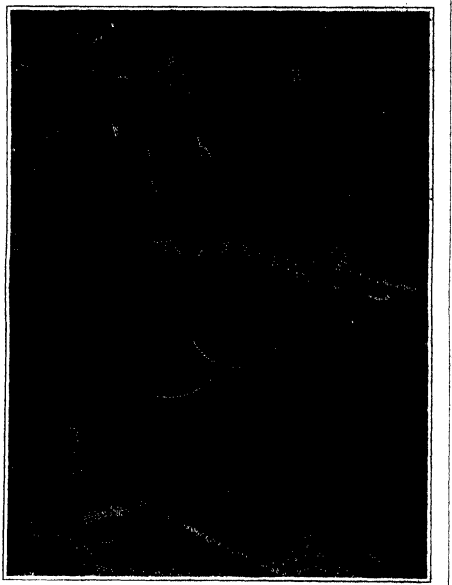
When the water in the main line of hose passes through the nozzle it sucks or draws the air from the outside through the small hose, so that it is available in abundance for breathing through the flexible pipes, so long as the water is flowing The principle is very much the same as the familiar water-blast pump of the laboratory, and the application seems to be no less successful Its particular usefulness will be in cellar fires, where dense smoke is usual and gives great trouble to firemen Here combustible rubbish is responsible for many serious fires, which often could be more promptly extinguished were the firemen able to get directly at the seat of trouble, instead of being forced to use cellar pipes directed from above

It is of further interest that this new device was supplied to a double section hose company in the high pressure district whose equipment now represents the last word to be said in fire department practice, and to this organization also has been assigned the fireman inventor This company has to deal with many cellar fires and the new smoke protector will not only have the surest possible trial but will be greatly appreciated by the firemen themselves Changing conditions in fire fighting demand improvements in apparatus and methods, and the mechanical training now being received by firemen is bound to produce many ingenious inventions, of which Mr Halloran's smoke protector is a sample.

Notes for Inventors

Aluminium Pulleys.—One of the big machinery concerns of this country recently made some pulleys of aluminium to meet some special conditions required by one of its patrons and the innovation proved to be such a desirable one that more were made at once and now they have been adopted as standard by that particular concern They are said to have many advantages over those of cast steel. It is necessary to make some slight departure from the usual shape but this is a very trivial matter

The Telautograph in Desks.—Telautograph machines, which reproduce a written message at more or less distant stations, have been introduced into desk drawers, for use by bank presidents and public men, enabling the latter to make inquiries of clerks and secretaries without the knowledge of the caller It is possible to write a message under these conditions and receive an answer concerning the personality or business of the individual seated at one's elbow, without leaving the desk or seeming to make any inquiries



A new device for enabling firemen to enter smoke-laden atmospheres.

A Striping Machine.—Striping is a branch of the painter's art which requires special qualifications and the man who has a reputation for good striping has no fear of losing his job Carriages, motors, machinery, farming implements and a great variety of similar articles are not regarded as properly finished if they are not striped This has always been done by hand, the painter using a long haired brush, but the greatest essentials to the work is a steady hand and a good eye. Thus equipped, he becomes so expert that he makes a straight line better than others do with a straight-edge. A hand device has been recently invented for performing this work, and it greatly facilitates the task for the reason that the painter is enabled to do twice as much work in a given time The apparatus is designed on the principle of the fountain pen. It fits in the palm of the hand and is supplied with a bulb by which the flow of paint is controlled A number of interchangeable wheels are supplied with the striper and with these it is possible to make a great variety of stripes as well as small borders, such as walls of Troy, oak leaves and similar designs.

A Safety Device for Trolley Cars.—A trolley car which cannot start while a passenger is in the act of alighting or boarding the car has been in experimental use for a short time at Portland, Me. Such a feature will prevent most of the accidents which railway companies are compelled to pay damages for, and if successful, will meet with immediate adoption wherever the open end cars are used. The invention consists of a hinged step which is depressed a distance of a half an inch by a weight of less than ten pounds. This depressed position of the step has the effect of breaking an electrical circuit connected with the contractor and the latter fails to close by any act of the motorman while there is any weight on the step. The same principle has been applied to the elevator which will prevent that kind of accident which is so common, that of the car starting when a person is just in the act of entering it, the prospective passenger being crushed between the car and the wall of the building. A section of the elevator floor at the entrance yields slightly under the weight of a person and this throws into action a safety device which prevents the starting of the car.

Bricks That Float.—At the present time there is no particular demand for a brick that will float but such a thing will be regarded as a curiosity the world around. In the development of a special brick, designed to be used as an insulation in the construction of cold storage plants, breweries and refrigeration plants and is meant to take the place of cork, flax, charcoal fiber and sawdust, all of which are imperfect insulating materials, the use of which is attended by foulness and rot or are otherwise offensive. The brick, in waterproofing, is so burned that 45 per cent of its volume is confined air, with the result that one of these bricks being cast upon the waters, will float along like a block of wood.

A New Letter Box.—The latest suggestion for letter boxes is one made of pressed steel, without any ledges or places in which a letter might become lodged in its interior. This is a trouble which exists despite the greatest care. Many letters are delayed or fail of delivery entirely by being caught inside the letter box and securely held there. Another feature of the new box is that it has a drop bottom, which is almost as great a consideration to the postal authorities as the smooth interior, for it permits a box filled with hundreds of letters to be emptied as quickly as another containing but a few letters The carrier's receptacle is swung under the box and the bottom opened so that all letters drop at once down into the bag without any possibility of loss or delay.

Another Worthington Pump Patent Expires.—The patent to Charles C. Worthington, No. 526,429, having issued September 25th, 1894, expired on September 25th, 1911. This patent involves the gradual closing of the valves at the end of the plunger stroke and enables a pump to be driven by a direct-acting steam engine with an increased velocity and avoids wear and tear upon the valves by slamming. Worthington has later patents still in force among which are Nos. 584,533, 584,534, No. 607,902 of July 26th, 1898, and No. 657,976 of September 18th, 1900. The original Worthington pump patent, No. 24,838, was issued July 19th, 1859, to Henry R Worthington and included two direct acting pumping engines propelled by steam or other fluid and so arranged that each engine actuated the inlet and outlet valves governing the motive power of the other, thereby insuring the constant action of at least one pump piston upon the water and relieving the action of the pump from shocks and concussions This was one of the most important pump patents ever issued and the invention was a valuable contribution to the art to which it relates.

Metal Cloth.—An entirely new product, which takes up a position about midway between artificial silks and the fibers hitherto known which have been made from metal, has just been placed upon the German market by a well-known Elberfeld firm. In contradistinction to the metal fibers so far known, Renar yarn does not consist of a metal core or man-thread spun round with tinsel, it is a core, made of any suitable medium which, by means of a special chemical process, is entirely covered with a metallic coating which becomes thoroughly incorporated with the core. At the same time all the metallic lustrous particles are so embedded in the external coat that they are protected against atmospheric or other extraneous influences, and thus maintain their sheen or luster for an indefinite period. The yarn is not only produced in the original colors of gold, silver, copper, old gold, etc, but is supplied in any modern shades required; all these colors are characterized by a fine, striking metallic luster which will not fail to please, and which are reminiscent of silk and metallic lustrous combinations. The yarn can also be worked up with artificial silk From experiments made, it is fully proven that this new yarn is perfectly "fast;" that is to say, it retains its color and never gets black or oxidized.

Patents to Former Examiners.—Among the patents issued on August 15th, 1911, is one, No. 1,000,414, to Charles J. Kintner of New York city, for a hose connection, and another, No. 1,000,476, to Oscar Woodward of Montclair, N. J., for a typewriting machine. Both of these inventors were formerly principal examiners in the United States Patent Office, and a patent, No. 1,000,425, for a valve, was issued on the same day to Edward N. Pagelsen of Detroit, Mich. Mr. Pagelsen was also, at one time, a member of the examining corps of the Patent Office.

RECENTLY PATENTED INVENTIONS.

Interesting items are given to all patentees. The specifications are obtained by special arrangement with the inventors. Terms on application to the Manufacturing Department of the SCIENTIFIC AMERICAN.

Dressmaking to Apparel.

COMBINED SCARF, SHAWL, AND SWEATER.—J. ADLER, New York, N. Y. This invention relates to clothing, and the object is to provide a wrap which may be used as a shawl or scarf, and when desired may be readily converted into a sweater. The combined scarf, shawl and sweater may be manufactured at very little expense and may be conveniently used in a number of ways to protect the body of the wearer.

Of Interest to Farmers.

COMBINED LISTER, PLANTER AND RIDGE BUST.—SAMUEL B. HAMILTON, R. 2, Wakefield, Kan. This inventor provides a mechanism which may be adjusted to space the operation of a lister plow to form parallel ridges; provides a frame for an implement of the character specified, having strength, lightness and durability; provides carrying wheels



COMBINED LISTER, PLANTER AND RIDGE BUSTER

arranged to cause the wheels to track toward the center of furrows, to form a revolving wedge the rearward spread whereof bears against the sides of furrows and prevents the drift of the wheels and implement, and provides a simple, durable and economical frame structure. The illustration shows a perspective view of the implement, constructed in accordance with Mr. Hamilton's invention.

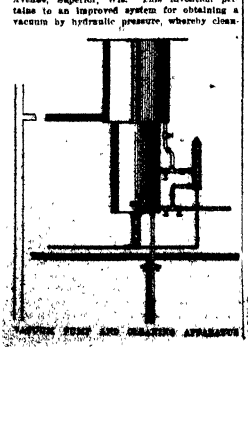
SPRING GUARD ATTACHMENT FOR CORN HARVESTERS.—J. H. BAEHR, Eden Valley, Minn. The invention provides an attachment which may be secured directly to the under side of the dividers, which is in the nature of a spring guard for preventing inclining of the stalks in their movement toward the binder table, or rather for holding them in vertical position. It may be attached to the under side of dividers of ordinary corn harvesters without interfering with the working parts thereof

Of General Interest.

MOLD FOR MAKING CONCRETE ARCH BLOCKS.—W. C. HOLMES, Scarboro-on-the-Hudson, N. Y. In the present patent the object of the invention is the provision of a new and improved mold, more especially designed for making arch blocks, and arranged to permit convenient adjustment of the mold parts for making blocks of different sizes for arches of different spans.

DISPLAY CARTON.—A. M. BOOS, Boston, Mass. This invention relates to display cartons, and has reference more particularly to a device, comprising a back, sides, a front, a top having an opening to receive the articles to be displayed, and an inclined bottom having gaps adapted to engage the lower ends of the articles, to assist in holding the same in position.

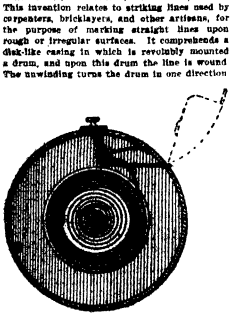
VACUUM PUMP AND CLEANING APPARATUS.—L. L. MONTGOMERY, 3506 Oaks Avenue, Superior, Wis. This invention pertains to an improved system for obtaining a vacuum by hydraulic pressure, whereby cleaning by vacuum may be accomplished, and which may be reversed to form, to a certain extent, a hydraulic air-compressing pump. A further object is to provide a system in which hydraulic means creates a vacuum or pressure, with means for automatically controlling the hydraulic means by the vacuum or pressure created. The device is simple in construction and inexpensive to manufacture, and is illustrated herewith in vertical section showing a fragmentary portion of the system in operation



VACUUM PUMP AND CLEANING APPARATUS

Hardware and Tools.

STRIKING LINE.—HENRY K. KING, 214 E. 20th Street, Manhattan, New York, N. Y. This invention relates to striking lines used by carpenters, bricklayers, and other artisans, for the purpose of marking straight lines upon rough or irregular surfaces. It comprehends a disk-like casing in which is revolubly mounted a drum, and upon this drum the line is wound. The unwinding turns the drum in one direction



STRIKING LINE

the drum being retracted by a spring. The casing is provided with a sector-like opening and fitting into this opening is a hollow door through which the line is drawn, and disposed within the hollow door is the inking apparatus. This patent is for sale. The device is illustrated herewith and is shown in perspective ready for use, the line being partially unwound

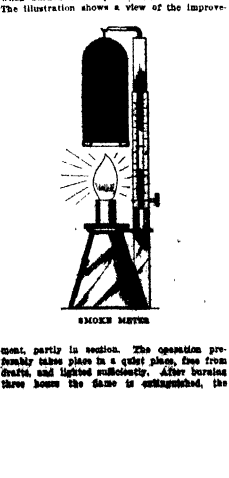
HOSE COUPLING.—FRITZ A. SCHNEIDER, 403 E. 125th Street, Bronx, New York, N. Y. The object here is to provide a coupling, arranged to permit quick coupling and uncoupling of the members, at the same time insuring a tight joint with a view to prevent leakage when the members are coupled. For this purpose use is made of coupling members, of which one is provided with a bayonet slot, and a spring-pressed locking device mounted to slide on one of the coupling members and provided with a key adapted to engage key-ways standing at an angle to the slot and stud. The plan view of the hose coupling as applied is pictured in the engraving



HOSE COUPLING

Heating and Lighting.

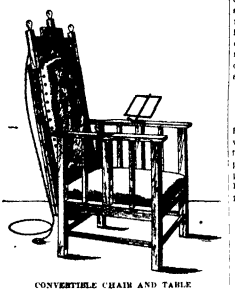
SMOKE METER.—FRANKLIN W. MANN, Franklin, Pa. This device determines the amount of unconsumed carbon in illuminants when burned under predetermined conditions. The illustration shows a view of the improvement, partly in section. The operation presumably takes place in a quiet place, free from drafts, and lighted sufficiently. After burning three hours the flame is extinguished, the mantles removed, and brought to normal temperature, preferably in an exsiccator, as is also the reservoir and the remainder of unconsumed oil. The reservoir and unconsumed illuminant are then weighed separately to ascertain the exact amount of illuminant consumed, and the net weight of unconsumed carbon is found by the difference in weight between the mantles before and after use



SMOKE METER

Household Utilities.

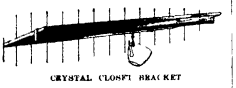
CONVERTIBLE CHAIR AND TABLE.—ISRAEL HOFFMAN, 85 Lenox Avenue, New York, N. Y. The invention provides a convertible chair and table, arranged to permit of conveniently and quickly changing the table into a chair and vice versa, and when in the form of a chair a book rest is provided for reading purposes, electric lights for the proper illumination of the reading matter and a receiver for



CONVERTIBLE CHAIR AND TABLE

cigar or cigarette ashes, burned matches, etc. The frame has arm rests, chair seat, combined chair back and table top provided with means to swing the back and table top onto the top of the arm rests, to provide a table or to swing it into position to form a chair. The accompanying illustration shows the convertible chair and the table set up to form a chair.

CRYSTAL CLOSET BRACKET.—RACHEL JAFFE, Borough of Manhattan, New York, N. Y. The accompanying engraving is a perspective view of this invention applied to a glass shelf. The invention relates to a new and improved form of depending bracket, and is particularly adapted to form a bracket for

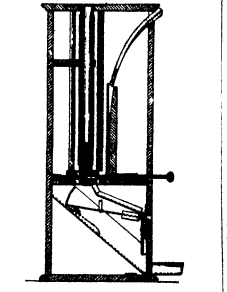


CRYSTAL CLOSET BRACKET

a glass shelf such as used in crystal closets where it is inconvenient or impossible to attach a supporting means for the bracket directly to the glass. By means of her improved bracket, a means is afforded whereby cups or other articles may be suspended beneath the glass shelf without in any way interfering with or modifying the construction of the glass shelf

Machines and Mechanical Devices.

CHANGE MAKING MACHINE.—JOHN R. CONRAD, Canajoharie, N. Y. Through a slot



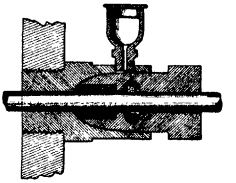
CHANGE MAKING MACHINE

in the machine the coin to be changed is introduced and will fall to a position in front of a plunger to operate a slide when the plunger is actuated, the slide having an opening therethrough adapted to register with the coin cylinder above an opening in the partition on which the slide rests, so that when the opening in the slide registers with the cylinder, coins will descend and rest on the partition, and when the slide is moved relatively to the partition, coins within the opening between the planes of the slide will be moved with the slide until the opening therein registers with the opening in the partition, when coins will fall through the last mentioned opening. A perspective view of the machine is pictured in the engraving

CHECK CONTROL STAMPING MACHINE.—PETER LAMBERT, 161 West 54th Street, New York City. This invention is comprehended in a receptacle adapted to receive mail matter, the receptacle being provided with means for stamping the serial number, together with the hour and date of mailing, and an inscription stating that the required amount of postage has been paid. The object of the invention is to provide a mail box adapted to receive the proper amount of coin for postage when the matter to be mailed is inserted in the box, it being especially adapted for use under the control of the government in public places, thereby providing for considerable saving in the selling of stamps and the handling of mail matter

Prime Movers and Their Accessories.

STUFFING BOX.—LOUIS CIRAC, care of Hon. D. C. McDonald, Ely, Nevada. This invention is an improvement in packing or stuffing boxes for use on piston rods, valve rods, pump plungers or other similar devices wherein packing is utilized to surround a rod or the like, and the invention has for its object the provision of a simple construction which can

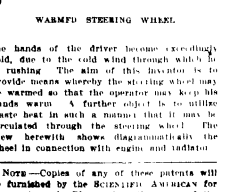


STUFFING BOX

be easily operated to compress the packing and secure a proper packing of the joint and by which lubricant may be supplied directly to the packing through openings in the devices for compressing the packing. It provides efficient lubrication, convenient renewal of the packing and a ready adjustment of the parts whenever necessary or desired. This invention as in use is shown in the engraving in longitudinal section

Pertaining to Vehicles.

WARMED STEERING WHEEL.—EDWARD F. REICHERT, Jr., Room 212, 1547 Broadway, New York, N. Y. This invention refers to a steering wheel with appliances for warming the same so as to keep the operator's hands in a comfortable condition. It is well known that in the case of launches, aeroplanes, or in open automobiles without protecting wind shield,



WARMED STEERING WHEEL

the hands of the driver become exceedingly cold, due to the cold wind striking which he is rushing. The aim of this invention is to provide means whereby the steering wheel may be warmed so that the operator may keep his hands warm. A further object is to utilize waste heat in such a manner that it may be circulated through the steering wheel. The view herewith shows diagrammatically the wheel in connection with engine and radiator.

NOTE.—Copies of any of these patents will be furnished by the SCIENTIFIC AMERICAN for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

NEW BOOKS, ETC.

RESEARCHES ON THE EVOLUTION OF THE SOLAR SYSTEM. Vol II By Prof T J J See. 1910 735 pp, 4to; 57 full-page insert plates

In place of Laplace's theory that rings of vapor were once thrown off from the sun to form the planets, and from the planets to form the satellites, Prof. See offers us his capture theory Instead of regarding the planets as gradually detached from the sun and set revolving in approximately circular orbits Prof See endeavors to show that the planets have developed from small nuclei originating in our nebula, at a great distance from the sun, and that their orbits have since been reduced in size and rounded into almost perfect circles by moving in a resisting medium If that idea is true the planets were never part of the sun, and Laplace's ideas are wrong Similarly, Prof See endeavors to show that satellites now revolving about the planets were originally independent bodies moving in regular elliptical orbits about the sun, but that they were afterward captured and made satellites by dropping in toward the planets about which they now revolve An existing medium in the form of cosmical dust is assumed to be responsible for the capture of the satellites The effects of repulsive forces in nature are dwelt upon in this volume even to greater extent than attractive forces Heavy bodies drifting toward powerful centers of attraction under the action of gravitation alone are assumed to pass into smaller and rounder orbits, with each revolution, by moving in this resisting medium Light bodies of small mass, in the form of fine cosmical dust are driven away from the stars by repulsive force and thus lead to the formation of nebulæ In remote regions of space Accordingly, the repulsive force at work in the stars scatters the dust to form the nebulæ, the condensation of the nebulæ forms the stars, so that a cyclical process is at work in the universe, the nebulæ producing the stars and the stars in turn reproducing the nebulæ Adequate analysis of Prof See's work can be undertaken only by an astronomer who takes the trouble to check up his calculations He has a daring piece of theorizing on the basis of modern discoveries and mathematical calculation, Prof See's book must certainly command respect It cost him four years of hard work to produce it a fact which is amply demonstrated by its size

THE CONQUEST OF THE AIR By Alphonse Berget G P Putnam's Sons, 1911 249 pp Numerous Illustrations

This second edition of Prof Berget's book has been considerably re written in the effort to bring it up to date That effort has not been altogether successful We learn, for example, that the Wright machine still starts on rails, although, as a matter of fact, the Wright machine has for some time been running on wheels like most biplanes and monoplanes Apparently, the Wright brothers count for very little as inventors with Prof Berget He regards them as mere imitators of Chanute and Lilienthal, and he credits Blériot as the real inventor of the man-carrying aeroplane We learn with some astonishment that the Wright machine owes its success entirely to the remarkable skill of the Wright brothers as pilots, although the author does not point out wherein the operation of a Blériot or any other machine with warping wings is easier The part played by such men as Maxim and Langley in the development of flying machines is not sufficiently apparent Indeed, the chief criticism we have to make against this book is the spirit of French jingoism in which it is wrought This applies not only to the discussion of the flying machine, but to the discussion of the dirigible as well If the reader can overlook these faults, he will find here a good deal of sound aeronautical and aviation principle laid down in a straightforward way which cannot but prove instructive to the man who knows nothing of the subject The translation we regret to state is not altogether idiomatic and is evidently done by someone not thoroughly familiar with the subject

THE PRINCIPLES OF SCIENTIFIC MANAGEMENT By Frederick Winslow Taylor, M E, Sc D New York Harper & Brothers, 1911 Price, $1.50 net

These much discussed principles are the fruit of Mr Taylor's thirty years of experience and experimenting Briefly, his claims are that by the discovery of the laws governing labor fatigue and rest and by the science application to well planned tasks, he is able to double and quadruple the output of his men without pushing them to the point of exhaustion For example a man who under the old conditions loaded 12½ tons of pig iron per day, now transfers 47½ tons from the pile to the car In the case of shovelers, the determination of the shovel load is a question of prime importance and with each different occupation there enters new factors that must be painstakingly weighed and reduced to scientific formulæ In the face of much shrewd criticism, Mr Taylor has no less shrewdly defended his position and his theories There is little doubt that his discoveries inaugurate an era of vastly improved methods, particularly among the heavier occupations It will be found impossible, however, to reduce the more complex human activities to exact formulæ without destroying to a certain extent the spontaneity, the elasticity, which comes of man's sense of personal mastery and freedom To use an illustration from athletics, no two jumpers clear the bar in exactly the same way, and to force one method upon all tyros would soon reduce the number of potential champions So long as the installation of the new methods is intrusted only to capable organizers, and a sufficient margin of safety is maintained to allow the varying personal equation, the spread of these principles of scientific management will be attended only by gratifying results

HISTORY OF THE SHERMAN LAW By Albert H Walker of the New York Bar New York The Equity Press, 1910 8vo, 320 pp Price, $2

The writer characterizes the Sherman Law as a latter day Magna Charta, a defensive weapon by which the craft of the well-in trenched minority should be shorn of its power to dictate prices on the products necessary to the life of the exposed and helpless majority Never before has the history of this Law's birth, its fight for life, and its final victory been presented in this compact and well condensed yet adequate form It makes a readable chapter in our history that should be welcomed by all who have the welfare of the nation at heart Thousands of speeches, arguments, and decisions have been taken by Mr Walker and boiled down until the substance of them all is given, and well given too, within the space of some three hundred pages

OUR HOME CITY By William Arthur, Omaha, Nebraska William Arthur, 1911 12mo, 133 pp Price, 25 cents

This is the description of an ideal city from the author's point of view His proposal is that a thousand families shall own their site at agricultural prices, each family building on land leased from the city The city keeps the title to all land, and owns and operates all public utilities A plan of such a city forms the cover design of the booklet and presents a lay-out that combines symmetry with accessibility and convenience

LOMBROSO'S CRIMINAL MAN By Gina Lombroso Ferrero New York and London G P Putnam's Sons, 1911 8vo, 332 pp Illustrated

Lombroso's criminological theories gave penology a new twist More and more we are beginning to regard the criminal not as a savage whom civilization has failed to tame, but as a diseased personality, a subject for the hospital rather than the prison The book before us is by Lombroso's daughter, Madame Gina Lombroso Ferrero, a lady who has done not a little psychological research on her own account and is therefore peculiarly well fitted to present a book on her famous father's criminological investigations Madame Ferrero's book, judging from the text, is intended primarily for the thoughtful reader who has no particular scientific training but who wishes to keep abreast of the scientific times For such a reader the book seems eminently well qualified Prof Lombroso has read the entire manuscript before his death and prepared an interesting introduction in which he traces the manner in which he conceived his theory of crime

ELEKTRO HEMISCHE UMFORMER By Johannes Zacharias Vienna and Leipzig A Hartleben, 1911 261 pp

This book is a very good review of the progress which has been made in the manufacture of galvanic current producers and their application

DAS SCHICKSAL DER PLANETEN. By Svante Arrhenius Leipzig Akademische Verlagsgesellschaft, m b.H A Hartleben, 1911

This is a reprint of Prof Arrhenius's essay on the Atmosphere of planets in Ostwald's "Annalen der Naturphilosophie" Arrhenius's conclusion may be thus summarized As the magma cooled a solid crust was formed Not until then was there an atmosphere or a planetary interior From the interior of the planet, gases particularly steam and carbon dioxide, exuded and arose to the highest levels of the atmosphere On this highly absorbent nascent atmosphere which flew above the clouds, sunlight reacts photo-chemically Because of the low temperatures of these upper layers, there is a great preponderance of photo-chemical reactions which are not appreciably affected by cold As the result of these photo-chemical reactions, and as a result of the ordinary reactions which occur later, oxygen and carbon dioxide are formed Both gases in the original atmosphere as hydrogen, hydrocarbons, which predominate in the outer layers of celestial bodies are gradually consumed by oxygen, so that finally, besides oxygen, only a few chemically inert gases remain such as nitrogen Steam and carbon dioxide, however, will continue to permeate the atmosphere through crevices in the planetary crust It was under these circumstances that life first developed This is the condition of the earth, and possibly of Venus. Gradually the thickness of the crust increases, gradually the waters evaporate, gradually volcanic action ceases, gradually the surface of the planet is transformed into a desert, gradually vegetation dies away, gradually oxygen ceases to be produced, gradually, in a word, the living planet becomes a dead world

THE PRINCIPLES OF AEROPLANE CONSTRUCTION By Reukin Kennedy, C.E. New York D Van Nostrand Company, 1911 137 pp Price, $1.50.

In this excellent book Mr Kennedy has explained the principles of the aeroplane, and put in concise form the elementary laws of mechanics and the inclined plane which govern its construction Formulæ are presented for the determination of the principal dimensions of the aeroplane in its simplest form, with numerical worked out calculations with the two systems in use.

KOMETEN UND ELEKTRONEN By Augusto Right, Leipzig Akademische Verlagsgesellschaft m b H , 1911

In this admirable little monograph, Prof Right has applied the discoveries of the English school of physicists, who have given us the electronic theory, to the phenomena of comets Radiation pressure alone is not sufficient to explain many of the vagaries of a comet's tail But the application of the electron theory undoubtedly helps considerably to clear away many a mystery The last chapter in the monograph is devoted to the consideration of the passing of the earth through the tail of Halley's comet, on May 19th, 1910

FLYING MACHINES TO-DAY. By William Duane Ennis New York: D. Van Nostrand Company, 1911. 205 pp ; numerous illustrations. Price, $1.50.

Prof Ennis has written one of the most sensible books on flying machines that we have seen The title of his work, to be sure, is rather misleading, for he discusses lighter-than-air craft as well as aeroplanes. Written primarily for the layman, the book sets forth the principles of the aeroplane and the dirigible with such clearness that a man of average education ought to be able to understand the explanation It is difficult, of course, for a work on aviation to be strictly up-to-date, for the art progresses so rapidly that improvements are made almost from week to week Still, it must be said that the author made a commendable effort to keep his reader informed of the more recent progress in flying machine construction

THE UNIVERSAL RAILWAY MANUAL 1911. Containing Valuations of the Principal British, American, and Foreign Railway Stocks Edited by Capt L. E. Hopkins, R.E London: Society of Railway Stock Holders New York The Macmillan Company 12mo., 598 pp Price, $2.50 net

This valuable book is based on the company valuations, reports of government statistics, etc There is also a considerable free criticism as to the financial position of companies, which is rarely distinguished The work has been done in the most admirable manner, and the book is one of the best compendiums of financial information that we have ever seen The maps and diagrams are particularly clear, and the index which should be in the library of every well informed person Railway systems of the world form a most fascinating subject

CHARTS OF THE ATMOSPHERE FOR AERONAUTS AND AVIATORS By A Lawrence Rotch, S.B., A.M., and Andrew H. Palmer, A.M New York. John Wiley & Sons, 1911

This book of Prof Rotch's is the first attempt made in this country to collect for the use of the aviator and the aeronaut in a readily understood form, the vast amount of data which have been accumulated at the Blue Hill Meteorological Observatory, one of the pioneer institutions of its kind We believe that somewhat similar work has been done in Germany and Italy The book consists of a series of charts which gives the relative heights attained by various aerial vehicles, atmospheric density and temperature, average temperature, barometric pressure, wind velocity, and pressure up to 30,000 feet, maximum wind velocities and pressure up to 30,000 feet at Blue Hill, wind pressures for constant velocities up to 30,000 feet, wind pressures for constant velocities up to 10,000 feet, monthly temperatures up to 12,000 feet at Blue Hill, monthly rain up to 12,000 feet at Blue Hill, hourly wind velocities up to 10,000 feet at Blue Hill, frequency of constant wind velocities, 1,000 to 10,000 feet at Blue Hill, frequency of winds at Blue Hill, 650 feet, velocity of winds at Blue Hill, 650 feet; frequency of winds at Blue Hill, 1,650 feet; velocity of winds at Blue Hill, 1,650 feet; frequency of winds at Blue Hill, 3,300 feet; velocity of winds at Blue Hill, 3,300 feet; frequency of winds at Blue Hill, 6,600 feet; velocity of winds at Blue Hill, 6,600 feet; frequency of winds at Blue Hill, 10,000 feet; velocity of winds at Blue Hill, 10,000 feet; wind velocity and direction up to 18,000 feet at St. Louis, winds at various heights as related to barometric pressure at the ground; frequency of winds in the N. E. trade region of the Atlantic Ocean, velocity of winds in the N. E trade region of the Atlantic Ocean; aerial routes in summer across the North Atlantic Ocean. Each chart is accompanied by simply-worded explanations, which will enable the aeronaut and the aviator to appreciate the significance of the facts conveyed by the charts.

Notes and Queries.

Kindly keep your queries on separate sheets of paper when corresponding about such matters as patents, subscriptions, books, etc. This will greatly facilitate answering your questions, as in many cases they have to be referred to experts The full name and address should be given on every sheet. No attention will be paid to unsigned queries. Full hints to correspondents are printed from time to time and will be mailed on request.

(12542) H. S. D. asks: Have you any publications regarding the making of ice by the vacuum process? I have placed a small amount of water under a bell jar with some sulphuric acid and have exhausted the air. The water cools but fails to freeze According to theory, should water freeze under the above conditions? Can you suggest any method for freezing water under the vacuum? A. The experiment of freezing water under a bell jar of a common air pump is a very difficult one The vacuum is usually too low. The metal of the pump is too good a heat conductor Water nearly as rapidly as the evaporation takes it out of the water. With a quick-acting high-grade pump, and by protecting the glass in which the water is contained from the metal of the pump, the freezing of the water will occur, but not rapidly. A very small and broad bell jar must be used. The sulphuric acid must be in a broad dish. The water is usually in a flat watch glass over the acid, supported by a wire frame which rests upon the glass dish in which the acid is put. The older books of physics usually have pictures of the arrangements. You will find it in Deschanel, Vol II, as well as the picture of Carre's apparatus for freezing water in bottles by the same method, which was once largely used, but has now gone out of use.

(12543) F K. writes. Occasionally I see mention made in your valuable journal by writers claiming to have seen ball lightning drop from the clouds, the accuracy of which is questioned by some and as being an illusion I distinctly remember one afternoon about 4 o'clock having seen such a ball drop from the clouds, was from a thunder cloud in the northwest sky I was facing the cloud at the time To me it appeared to be about six inches in diameter, and as it descended sparkled with short electric bristles until it reached terra firma. I was returning from a field at the time, and the distance between me and where it reached the earth to have been about half a mile This was at Centerhall, Pa I at once concluded when reaching the village to inquire whether the phenomenon had been observed there, and to my astonishment learned that "lightning had struck the house of Alex Shannon," followed the chimney down into the kitchen, where a little daughter was standing close to the range, and was instantly killed There was no other peal of lightning at the time, hence there can be no doubt that the ball lightning killed the little girl. The ball was about two and a half seconds in its descent A There was a time when the existence of a slowly moving globe of fire, a ball of electricity, which afterwards might explode with great force, producing all the effects of a lightning stroke, was denied and even ridiculed by scientific men We think all now admit the reality of these occurrences

(12544) W F M asks 1. Is iron or steel while very hot, or in a molten state, absolutely unaffected by magnetic lines of force? A Iron or steel above red heat cannot be magnetized 2 Will a thin sheet of iron held in front of the poles of a powerful magnet cut off all the "pull" of the magnet? A A thin sheet of iron will not cut off all lines of magnetic force A plate of sufficient thickness to furnish a path for the lines of force below saturation must be employed For a weight iron about 100,000 lines can be carried per square inch of cross section Even then there will be leakage into the air.

(12545) W. G M. asks. I have a pipe that leads from my well 14 feet higher than my sink I fill the pipe with water, and the water will flow from there to the sink, then stop I have put a pump on and sucked the water down and have the same trouble. I have to lift the water about 4 feet from the surface of the pipe there to go down. I would like to know the cause of its stopping, or how I can remedy it A The intermittent action you describe is inevitable with the simple siphon. Air carried into the pipe with the water escapes, as the pressure is reduced during the passage of the water up the pipe, and collects in the bend When sufficient air has accumulated, the water column breaks and the flow stops. Before the siphon can act, air must be removed by pumping it out or by refilling the pipe with water. These interruptions may be delayed by providing an air chamber at the high point of the siphon, so that the air may collect for a longer time before it interferes with the flow in the pipe. With a cock below the air chamber, and a plug or cock at the top, the whole air chamber may be filled with water whenever the collected air breaks the siphon's flow.

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The Harvest Moon

(Continued from page 804.)

angle of 66½ degrees to the plane of the ecliptic; and moreover the plane of the moon's orbit, which is inclined at an angle of a little over 5 degrees, has a retrograde motion, making a complete rotation in 18.6 years. The diminution of the retardation of the rising of the harvest moon is also variable, and dependent upon the latitude of the observer and the position of the moon's orbit. When the moon is midway between the nodes its direction of motion is parallel to the plane of the ecliptic. When it is at or near a node (which may be either ascending or descending) the direction forms an angle of about 5 degrees with the ecliptic.

The plot shows the positions of the earth (*E*) and of the moon at the dates of full moon—September 8th and October 7th; and also of new moon on September 22nd. The moon's orbit rotates in the direction of the arrow without the orbit; the arrow within the orbit is the direction of the moon's motion. Figs 1-4 represent the moon's orbit projected on a plane which is perpendicular to that of the ecliptic and parallel to the earth's axis. The scale is enlarged and shows the relative diameter of the earth and of the moon's orbit. *Fig.* 1 shows the plane of the orbit seen edgewise. In Fig. 2 the ellipse represent the orbit after one-quarter of a rotation. Fig 3 shows the plane of the orbit, again seen edgewise after one-half of a rotation. The ellipse Fig. 4 shows the orbit after three-quarters of a rotation. One-quarter of a rotation more brings the orbit back again to the position Fig 1. Fig. 5 is the position of the orbit in September of this year, and is situated between those shown at Figs 2 and 3. It is a view looking in the direction of the arrow *A*. In each of the illustrations the direction of the moon's motion is indicated by an arrow showing that part of the orbit which is near to, or farther from the reader.

Fig 6 is drawn to a very much larger scale, in order that the parallels of latitude on the earth's surface may be plainly visible, and to show some of the conditions which may affect the rising of the harvest moon. In order to bring the illustrations within the limits of the page, only a small part of the earth and two positions of the moon are included. The distance from *a* to *b*, and from *c* to *d*, show the average distance traversed by the moon in 24 hours, when it reaches the maximum distance above and below the plane of the ecliptic. If the positions *a* and *b* (below the ecliptic) were equidistant from *e* and from the earth's center, the moon would rise on consecutive evenings at exactly the same time to an observer situated very near *P* on the visible hemisphere. Also if the moon occupied the positions *c* and *d* (above the ecliptic) under similar conditions it would rise at the same time on consecutive evenings to an observer situated very near *P* on the invisible hemisphere. In the first case the plane of the moon's orbit passes through *a* and *b*: in the second it passes through *c* and *d*. In order to realize that the position of the observer in each case is near *P*, it must be remembered that the moon's distance from the earth is more than sixty times the earth's radius. The latitude of *P* is 66½ degrees (the polar circle). It is a well known fact that the harvest moon rises at or about the same time on consecutive evenings, in the north of Norway and Sweden. From an inspection of Fig. 6 it is evident that there would be a retardation at lower latitudes—as for example that of New York at *Q*.

When the plane of the moon's orbit is in the position corresponding to Fig. 1 forming a small angle with the equator; and the moon on consecutive evenings is at *f* and *g*, the retardation of the moon's rising is evidently greater than when the direction of the moon's motion is parallel to the ecliptic. When the orbit is rotated into the position corresponding to Fig. 3, and the moon on consecutive evenings is at *h* and *k*, the plane forms a larger angle with the equator, and the retardation is diminished. The illustrations might be extended indefinitely; but in general those here given show that in high latitudes the retardation is less than in lower latitudes, and that under favorable conditions at a high latitude, the moon may rise even earlier the second evening.

Fig 7 shows the plane of the horizon when the moon is above and below the ecliptic, and also the positions of the observer *p* and *p'* at the time of moon rise

Submarine Cables and Longitude Determination

(Concluded from page 806.)

strong enough to operate the electro-magnets. This cannot be done when the stations are connected by a long submarine cable, because the impulsive currents are too feeble to affect any but extremely sensitive receiving apparatus.

This difficulty has been overcome by Col. Bourgeois director of the geographical service of the French army, who was recently commissioned to devise a method of determining the difference of longitude between Brest, in France, and Dakar, in Senegal, which are connected by a cable about 2,800 miles long.

The receiving instrument employed in submarine telegraphy is the siphon recorder, invented by Sir William Thomson (Lord Kelvin). This instrument consists essentially of two very powerful electro-magnets between which is suspended, by two parallel fibers of cocoon silk, a small and light coil containing a great number of turns of very fine wire. The strength of the magnetic field is increased by a core of soft iron, fixed immovably inside the coil, which can turn freely without touching either the core or the electro-magnets. The coil, when no current is passing through it, is held parallel to the line of the magnetic poles by its bipolar suspension, but a positive or negative current causes it to deviate to the right or left from its position of equilibrium. A system of levers magnifies these movements and transmits them to a little glass siphon formed of a bent capillary tube. The short leg of the siphon dips into a vessel filled with a very fluid ink, and the long leg, which is drawn out to a fine point, moves transversely in front of a strip of paper, which is drawn along uniformly by clockwork. The ink is electrified by a small electrostatic machine and is therefore projected upon the paper in a continuous spray. When the siphon is at rest this spray marks a straight line parallel with the length of the moving strip of paper, but when the siphon is turned to right and left by the moving coil the result is a wavy line, the elevations and depressions of which correspond to the dots and dashes of the Morse code

Col. Bourgeois's method of determining longitudes by cable a double chronograph and a single siphon recorder are employed at each station. The chronograph is used to compare an auxiliary clock with the standard astronomical clock, while the siphon recorder is connected through a local battery with this auxiliary local clock and through the cable with the standard auxiliary clock of the distant station. Hence the jet of ink traces on the moving strip of paper a straight line interrupted by two series of indentations each representing intervals of a definite fraction of one second, the odd numbered indentations (for example) being made by the distant standard clock, and the even-numbered indentations by the local auxiliary clock, the error of which, with respect to the local standard clock, is known from the chronograph record. In the preliminary experiments it was discovered that the siphon recorder and the chronograph pen, both of which are connected with the auxiliary clock, are not equally quick in action, but as the difference is less than 1/100 second, it is of no practical importance. The indentations produced by the siphon recorder are less sharply defined than the marks made by the chronograph pen, but they are quite sharp enough for the determination of longitude.

A Radium Lode.—According to press dispatches, Dr. Douglas Mawson announces that he has discovered a valuable deposit of radium ore at Mount Painter, in the far northern district of the State of South Australia. According to his report, the deposit is of high grade.



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Aeronautics

The International Balloon Race.—Nine balloons are entered in the international cup race which starts from Kansas City on October 2nd. America will be represented by Lieut. Frank P. Lahm, Capt. John Berry, and Wm. F. Assman; France by Emile Dubonnet, Alfred Le Blanc, and Welby Jourdan; and Germany by Lieut. Vogt, Ingenieur Gerickes, and Freiherr von Pohl.

Exhibition Flights at Brighton Beach.—As we go to press the American Aviation Co. is about to conduct an aviation meet at Brighton Beach Race Track on the 8th, 9th and 10th inst Flights will be made by Grahame-White, in his speedy Nieuport monoplane, by Harry N. Atwood, Wm Beatty in their Wright biplanes, and Eugene Ely in his Curtiss biplane This is the first attempt to use the Brighton Beach Race Track for flying that has been made in some time, and it is hoped that it will meet with success and with the patronage of the New York public, as if this is the case, there will probably be more exhibition flights made there in the near future.

The Aviation Meet on Long Island.—The first big aviation meet to be held in the East opened on the 23rd inst. at the Nassau Boulevard aerodrome of the Aero Club of New York. Mlle. Helene Dutrieu, who pilots a Farman biplane, has come from France to compete against our American aviatresses, Miss Quimby and Miss Moisant A demonstration of military aviation was given the first day of the meet. An official aeroplane postal service was also maintained from the aerodrome to the outskirts of Brooklyn, so that letters or souvenir postals mailed on the grounds could be carried through the air almost immediately Various novel races and contests are also on the programme

A Wonderful Altitude Record.—In our last issue, we mentioned Beachy's new altitude record of 11,640 feet made at Chicago recently. This has since been exceeded by 2,000 feet by Garros in a Blériot monoplane On September 4th this daring French aviator ascended to a height of over 2½ miles (4,600 meters), or 12,954 feet. This startling performance would indicate that there is no limit to the height to which an aeroplane can soar Garros reached an elevation almost as high as Pike's Peak, in Colorado. It has always been supposed that the monoplane was more difficult to drive to such great elevations than the biplane, but such has been demonstrated to be untrue and the monoplane now holds the palm for height as well as for speed

A New Michelin Prize for War Aeroplanes.—Mons Michelin has just offered a new prize of $20,000 for bomb dropping by aeroplanes Mons Michelin, it will be remembered, offered a like amount for a flight of some 225 miles from Paris to the Puy de Dôme Mountain over three years ago, this prize being won last March—exactly three years to a day after it was offered—by Reneaux on his Maurice Farman biplane Mons. Michelin believes in the future of the aeroplane and thinks that large prizes should continually be offered with the idea of perfecting it still further The rules of the new prize have not yet been drawn up, but the idea is to give the prize to the aviator who is most successful in dropping the greatest number of projectiles nearest to a given spot marked on the ground.

New York's Aviation Meet.—Despite the fact that the big meets recently held at Chicago and Boston have both been financial failures, the Aero Club of New York, of which Honorable Timothy L. Woodruff is President, expects to hold an International Meet at its Nassau Boulevard Aerodrome from the 23rd to the 30th of this month. Arrangements have been made for several of the well known foreign aviators to compete at this meet. Mlle. Dutrieu, the aviatress, who recently won the "Femina cup" for a long distance flight of 2 hours and 23 minutes cross country, in which she covered 106 miles, expects to compete in her special Henry Farman biplane. The army aviators will also probably conduct manœuvres showing the use of the aeroplane in warfare, and there may also be made some experiments in the transportation of mail by aeroplane.



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Engineering

Rare Metals in Canada.—It is reported that important deposits of platinum, iridium, palladium, rhodium and osmium have been discovered a few miles from Nelson, B C A well-defined dike bearing these metals is said to have been traced for several miles in the general direction of Forty-Nine Mile Creek and across the Kootenay River, and many claims have been staked.

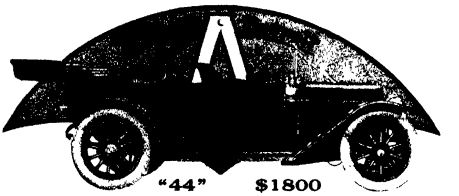
Edward Whymper.—The death of Edward Whymper removes the nestor of mountain climbers, the man who led the way up the Matterhorn in 1865 and first showed the possibilities of the Canadian Rockies. Whymper's wonderful achievement in ascending Chimborazo (20,500 feet), has been surpassed by others, but he will always remain a pioneer of distinction. Some of his books passed through many editions, and are now regarded as classics. Whymper was well advanced in his seventy-second year He died at Chamounix, among the tall mountains and glaciers he loved so well

The Lotschberg Tunnel.—Although the great Lötschberg tunnel is now open, it will be two years before trains are crossing the Bernese Oberland The new tunnel is nine miles long; a little shorter than the St Gothard, and three miles shorter than the Simplon It was built largely through the enterprise of the business men of Bern, in order to divert to that city a share of the transalpine traffic, most of which is now monopolized by other Swiss cities which are more favorably situated with respect to the Simplon and the St Gothard Its construction occupied four years and five months, and was marked by two great catastrophes, an avalanche and a cave-in, each of which cost a number of lives

Irrigation of the Yangtse Valley.—A project is now under consideration to construct an elaborate irrigation system in the Yangtse valley—possibly the most costly undertaking of this kind in the history of engineering Its object is twofold, viz., to improve the agricultural conditions of the country, and—more especially—to prevent a recurrence of the terrible floods which have devastated the valley during the present year. Independently of this project, Charles Jameson, the American engineer sent to China by the Red Cross Society, accompanied by an engineer deputed by the Chinese government, is about to make a survey of the famine districts of Kiangsu and Anhui, which are subject to these recurring floods

Progress of the African Railways.—By next July there will be continuous railway communication between Cape Town and the town of Kambove, in the Congo, 270 miles north of the Rhodesian boundary, a total distance of over 2,400 miles The railway is already in operation as far as Elizabethville, 165 miles north of the Congo border From Kambove an extension has been surveyed to Bukama, 200 miles farther north, on a navigable tributary of the Congo In a few months a railway will be begun from Kambove westward 100 miles to Ruwe. This is destined ultimately to connect up with the line that is being pushed eastward from Benguela, on the Atlantic coast, and which now extends 230 miles into the interior

Relics of the French Panama Canal.—On September 5th bids were opened in Washington for the French "scrap" that so picturesquely and tragically strews the route of the Panama Canal. It includes abandoned locomotives, dump cars, tanks, barges, dredges, boilers, girders, sheet iron, parts of old machinery, and miscellaneous junk—the relics of De Lesseps's greatest and most disastrous undertaking Every one who has visited the Isthmus has brought away vivid recollections of these gaunt monuments, as well as of the incredible tales with which they have come to be embroidered It used to be related that the French settlement of Christophe, adjoining Colon, was built on a foundation of locomotives dumped by the shipload into the virgin swamp. The material is to be removed by the contractor at his own expense, the Panama Railroad charging $2.25 a ton for its transportation to the seaports. Three years will be allowed for the removal.



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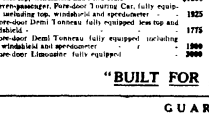
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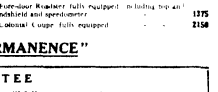
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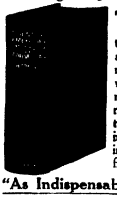
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Nos. 1816, 1817, 1818, 1819, 1820, 1821 and 1822. **The Practice and Theory of Aviation.** By Grover Cleveland Loening, A. M. This is the most compact paper on aeroplanes that has probably ever been published. Fourteen biplanes and monoplanes are described in detail, and illustrated with scale drawings, namely, the Farman, Cody, Curtiss, Wright, Voisin (old model), Voisin (new model), and Sommer biplanes, and the Antoinette, Santos-Dumont, Bleriot XI, Bleriot XII, Gnome, Pulsrie and Pfitzner monoplanes. The proper dimensioning of aeroplane surfaces, as deduced by famous experimenters from their tests, is also considered. The paper as a whole this series of newspapers constitutes an admirable text book.

No. 1713. **The Wright Aeroplane.** This is a thorough description of the old type of Wright biplane with the horizontal elevating rudder in the front of the machine. Excellent diagrams and photographic views accompany the paper.

No. 1756. **Louis Bleriot and His Aeroplanes.** Few people realize that Bleriot's successful monoplane is the result of ten years of daring and perilous experiment. In this paper will be found an instructive description of the evolution of the present successful Bleriot monoplane, illustrated with diagrams and photographs.

No. 1768. **The Farman Biplane.** A complete description of the Farman biplane, with detail drawings of the box tail and vertical rudder, the manner of working the four ailerons, hand and foot levers which control the machine, plan view and side elevation of the entire machine.

No. 1767. **The Santos-Dumont Monoplane.** An illustrated article describing the Demoiselle, the smallest and one of the fastest machines thus far made. Sketches accompany the article, showing the details of the construction and control.

No. 1582. **How to Make a Gliding Machine.** Full details and drawings which will enable anyone to make a glider for $15.00.

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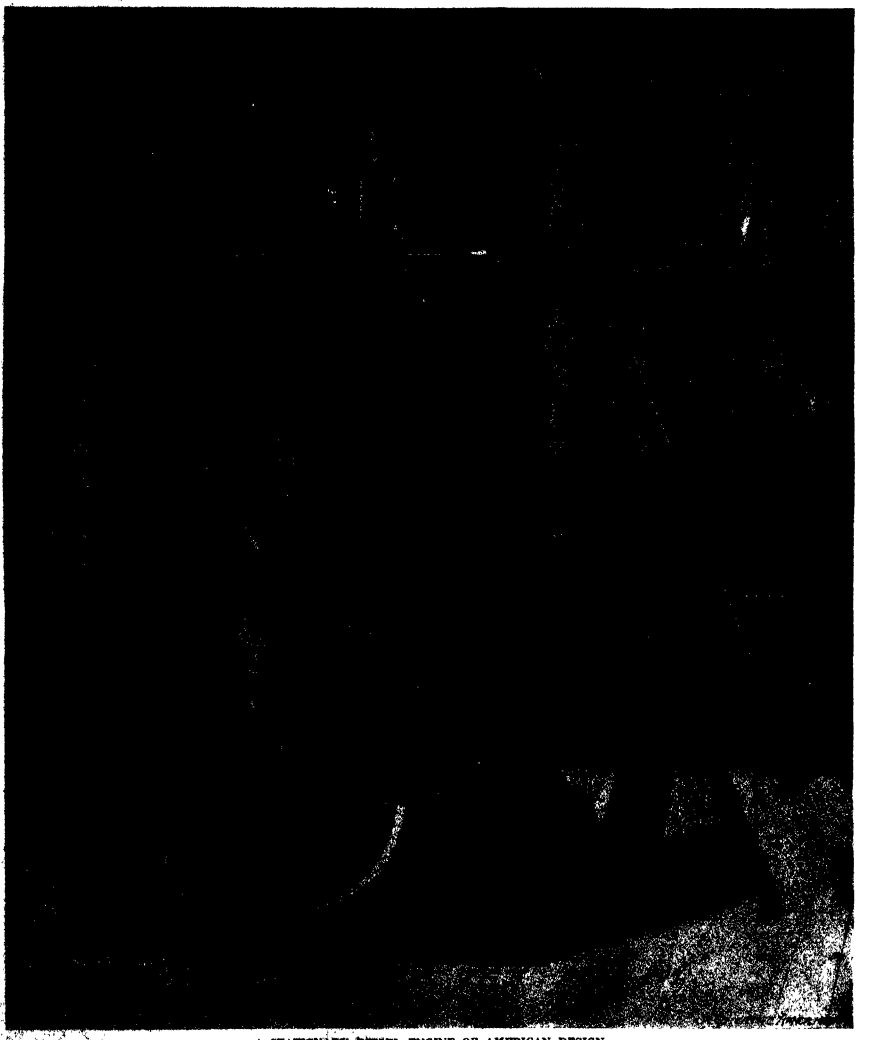
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THE WEEKLY JOURNAL OF PRACTICAL INFORMATION

VOLUME CV. No. 15.] NEW YORK, OCTOBER 7, 1911 [10 CENTS A COPY $3.00 A YEAR



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SCIENTIFIC AMERICAN

Founded 1845

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The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

The purpose of this journal is to record accurately, simply, and interestingly, the world's progress in scientific knowledge and industrial achievement.

The "Liberté" and the "Maine"

IT was inevitable that the destruction of the French battleship "Liberte" by the explosion of her magazines would revive in our minds the loss of the "Maine." Whatever the first cause, the results in each case were so identical, both in the loss of life and the complete destruction of the ship, as to make it certain that it was the letting loose of the enormous energy stored in the powder magazines that tore the two ships asunder and sent them swiftly to the bottom. At the present time it is hopeless to attempt to arrive at any satisfactory conclusion as to the ultimate cause of this horrible tragedy on the French ship. The dispatches contain the usual and inevitable mass of contradictory statements of eye witnesses and suggestions by experts. This, however, is certain, that among professional men in this country, both naval and military there is a grave suspicion that there is something wrong with the French smokeless powders. With the *similar accident* to the "Iena" fresh in mind, this suspicion is unavoidable. We notice that *one* apparently official dispatch states that all smokeless powder is being landed from certain ships, and that some of this powder was manufactured as far back as 1902—a period which antedates by several years the "Iena" disaster.

On the other hand, if it be true that a fire started in the paint room and ran from there to the coal bunkers and magazines, the question will at once be asked, "What in the world is a paint room doing down below the protective deck and in contiguity to the magazines?" On the ships of our navy the paint room is located immediately under the forecastle deck and up in the very eyes of the ship at the bow. And if a fire that proved difficult to control did break out below the protective deck, why, it will be asked, were not the magazines immediately flooded? Perhaps the answer is to be found in a cabled dispatch, which states that the commander of one of the French ships who recently flooded his magazines on the outbreak of a fire received a reprimand on the ground that his action was too precipitate.

It is pathetic that the gifted people who gave to the world that smokeless powder which has revolutionized naval construction should themselves so frequently be the victims of their own invention. If the "Liberte" disaster leads to a thorough overhauling and reorganization of the French navy (and the unending list of naval disasters strongly suggests that such an upheaval is necessary) the loss of the "Liberté," costly and tragic as it is, will not have happened in vain.

Section of Battleship for Big-gun Attack

THE tendency of target practice, as far as appropriations will allow, is in the direction of substituting the actual ship and solid armor for the time-honored canvas screen—and this for obvious reasons. Although the canvas target serves admirably its purpose of showing the accuracy of gun-fire, it gives no indication whatever of the punishing effect of such shots as get home upon the mark. Hitherto we have depended almost entirely for such information upon the results obtained by firing at armor plate, set up at a proving ground and attacked by a gun a few hundred feet in front of the target, whose projectiles have been delivered with reduced powder charges, giving a low velocity, corresponding to that at which the projectiles in an actual engagement would reach the ship when fired at long ranges. A disadvantage of most proving-ground trials is that the projectiles strike the plate normally to its face, and therefore under the best conditions for penetration, whereas in an engagement, carried out at ranges of from eight thousand to twelve thousand yards, the shells will be descending at an angle of from seven to ten or more degrees.

Our ordnance officers have always recognised these facts, and it is only recently that a liberal policy and more generous appropriations have enabled them to test the resistance of the armor and the ship under conditions at least approximating those of the future sea fight. Our readers will have in mind the "Katahdin" experiments, when heavy armor plate which had been erected on this obsolete vessel was attacked by a 12-inch gun, at ranges of 8,000 yards and up. Even more valuable in the information gained was the famous target practice against the "San Marcos," formerly the "Texas." Here the test was of the resisting power, not only of the armor, but of the whole ship itself, to modern gun attack.

It is necessary to take but one step further to give the navy absolute information on this subject, and this would be to sacrifice one of our modern ships, carrying the latest armor, backed up by the most approved methods of interior reinforcement and subdivision, by mooring her in Chesapeake Bay and permitting one of our latest ships to subject her to a bombardment similar to that which tore the "San Marcos" to pieces and quickly sent her to the bottom. But not even the information of priceless value which could be thus secured would warrant so costly an experiment.

There is, however, a cheaper way to secure the desired information. That is by building a floating structure of limited displacement, representing an exact section of a modern battleship, whose behavior under gun attack would be sufficiently similar to that of the ship itself to afford our naval constructors and ordnance officers a large amount of greatly needed information. Now, it is exceedingly gratifying to learn that there has been constructed at the Norfolk Navy Yard an experimental caisson which represents a battleship on one side and a cruiser on the other.

The caisson is being subjected to attack by guns, big and little, at ranges corresponding to those which may obtain in the various stages of a hard-fought naval engagement. In the present case, there is no such wholesale bombardment as marked the spectacular destruction of the "San Marcos." That sham battle was carried on mainly as a test of the accuracy of our modern system of correcting the range by spotting the fall of the shots. The tearing of the old ship to pieces was a foregone conclusion. Outside of the fact that it lent a touch of realism for the officers and men, and provided no end of stimulating "copy" for the press of the country, the lessons of the bombardment were necessarily, because of the great age of the ship, of limited value.

In the attacks on the caisson, however, we venture to think that after every single successful hit, the structure will be visited by officers of the line and staff, who will take careful count by photograph, and sketch and note book, of every detail of the damage inflicted. Each hit will have its own story to tell; and thus by alternate attack and inspection, round by round, our navy will lay in a store of practical information, the like of which, we venture to say, has never before been gathered by any navy in the world.

Foreign Students at German Universities

THE fame of the German universities is such as to render it quite unnecessary to extol their praise or to recite at length the many virtues for which they are so deservedly held in universal esteem. A question which invites discussion, however, is the influence, both upon Germany and upon the other countries, which the steady migration of students from abroad to the German seats of learning, and their subsequent return to their home countries, must exert both on Germany and upon the world at large. There is something slightly humiliating in the thought that we—and we do not stand alone in this matter—must needs send some of our best students to Germany, so that they may there receive what our universities seem to be unable to give them. While we would not for a moment entertain the desire or hope that this flow of young American manhood to Germany should ever diminish, yet we may very well harbor the wish that the causes for it may in time change, and that there may be an equal inducement in days to come for German students to visit our schools. There can be little doubt that a certain kind of academic work receives more attention and appreciation in Europe than it does with us, and possibly the causes for this are so deeply ingrained in the American national character that they can never be removed. In that case, the future to which we must look forward is that in time our universities may develop their own special points of excellence, for which they will be sought out by students from abroad. To some extent this is, no doubt, the case even now. Those who have themselves imbibed a little of the spirit of the old-world devotion to scientific investigation and to the study of art and literature, will, we think, hardly be quite satisfied with such a programme. Only the future can show just what course events will take.

Much more might be said on this side of the question, the influence of foreign studies upon our own country. There is, however, another aspect to the situation, which has recently been discussed in the pages of the *Zeitschrift für angewandte Chemie* by J. Bronn, namely, the effect which the extensive visitation of German universities by foreign students must have upon Germany itself. There are those, among the Germans, who feel some entirely justifiable jealousy in seeing the citizens of other countries, sometimes not particularly friendly to Germany, reaping of the harvest sown specifically for Germans by Germans. That such feelings should be voiced is perfectly natural, but it is also quite obvious that they are framed from a rather narrow point of view, which is not only somewhat repellent, owing to its selfish ring, but in view of the failure to take into account certain factors, is probably entirely fallacious. And these factors assuredly far more than compensate for any losses which Germany may suffer in the way indicated. Mr. Bronn considers the effect of the attendance of foreigners at German universities, first upon the state, secondly upon German industries as a whole, and thirdly upon the chemical industry in particular.

As regards the first point he observes that Germany as a State does not enjoy very great popularity among other nations, and he points out that this fact cannot be viewed with indifference by a country which, like Germany, carries on extensive export trade. The young student arrives in Germany with a good stock of prejudice, and instead of mixing with the natives, as would be best for all concerned, prefers to keep aloof and frequent only the company of his own countrymen. It is usually not until after two or three years' sojourn that he begins to become acclimatised, and from this point on he learns to appreciate the good points of German character and German customs. He returns to his home country with his views radically changed, and takes every opportunity, if only in a spirit of contradiction, to sing the praises of Germany. The value to Germany of this kind of missionary work can not be estimated too highly.

Passing on to the discussion of the second point, namely, the effect upon Germany industry of an increase in the enrollment of foreigners at the German universities, Mr. Bronn remarks that such effect must be slight, for foreign students, practically without exception, return to their home country after the completion of their studies. There is, therefore, no question of competition by the stranger with the native fog industrial positions.

On the other hand, the market for German products is most favorably influenced, for the man who has been trained in Germany will invariably give his first thought to German wares when considering the purchase of goods or machinery which cannot be procured in his own country.

Finally, as to the third point, the effect of foreign students upon the chemical industry of Germany, the same remark applies with regard to German exports in this field, as was made above with reference to German exports generally. The fear may be expressed that the graduate from a German university, upon settling down in his home country, will make use of the knowledge imbibed from German sources to place upon the market by home production the wares which until then had been imported from Germany. But as a matter of fact, every chemist knows that the mere university training, without experience in actual manufacture, is quite insufficient to enable a man to successfully establish a manufacturing installation on his own initiative, to say nothing of the very serious questions of capital, raw material, etc., which place severe obstacles in the path.



Fig. 1.—This reads 83,600 cubic feet.

The Meter

That Inexorable Mechanical Accountant of the Gas Company

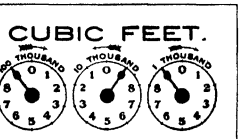


Fig. 2.—This reads 88,900 cubic feet.

NINE-TENTHS of the distrust in which the gas meter is almost universally held is directly traceable to its obscure location in the dark, unpleasant surroundings of the cellar. We feel sure that the man who is loudest in his denunciation of this "instrument of extortion" makes no daily or even weekly trips down his cellar stairs for the purpose of verifying the totals footed up by the gas meter. If he did we are confident that much of his distrust would give way to respect. This same man may be most scrupulous about all his other accounts and would think it the height of absurdity to jot down his expenditures but once a month, with no memoranda to assist him in recalling the various items. Yet with ridiculous inconsistency he is ready to denounce any enlargement of the gas bill, forgetting that a whist party and a few friends to dinner or a succession of cloudy afternoons may have increased his gas-light hours—hours that are by no means overlooked by the mechanical accountant of the gas company.

However, we are not writing a defense of the gas meter. It is by no means a perfect instrument, hence the necessity of checking its records periodically. Unfortunately not one man in a thousand knows how to read a meter, yet there is no great mystery about it. Directions are published either on the back of the gas bill or on cards issued by the gas company, which may be had for the asking.

The meter is usually provided with three or four dials, each graduated in ten divisions. A small dial marked "Two feet" may be ignored for the present, as it is used only for testing purposes. The dial to the right is marked "1 thousand" and each of the divisions stands for 100 cubic feet, the entire circuit of the dial representing one thousand feet. On the next dial, marked "10 thousand," the hand moves in the opposite direction and each division stands for a thousand feet. In the same way each division of the dial marked "100 thousand" stands for ten thousand feet. Fig. 1 shows a simple example which will illustrate the method of reading. From this reading, the reading of the previous month is subtracted to show the amount of gas used in the interim. It should be noted that when a hand lies between two figures, the lesser number is read.

It is sometimes puzzling to know whether a hand lies on a figure or not, and this can be determined only by referring back to the dial on the right. For instance, if all three hands pointed to 9, we might carelessly put down the reading 99,900, which would be just 11,000 cubic feet out of the way. The true reading is 88,900, as a moment's consideration will show. The fact is made clearer by referring to the hands of a clock. When the hour hand of the clock points to X, and the minute hand to XI, we read not 10.55, but 9.55, because the minute hand shows us that the hour hand has not yet reached X. And so with the gas meter hands; the hand of the first dial shows that the hand of the second dial has not quite reached 9, although it may appear to be covering that number, while the hand of the second dial shows that the hand of the third one has not yet reached 9. It happens not infrequently that a meter inspector will make a mistake in such a reading, which may boost the gas bill considerably. Of course, the fault will right itself eventually, for at the end of the next month, there will be a larger subtrahend to deduct from the meter reading, and a correspondingly smaller bill. Sometimes an inspector, knowing about how much gas is used, will guess at the reading, if he finds it impossible or inconvenient to reach the meter when on his rounds, making his estimate low so as to be on the safe side. Then when he does make a *bona fide* reading, the gas bill will show a sudden rise, making up for the accumulated deficiencies of the inspector's low estimates.

In 1907, the Public Service Commission of the First District of New York took over the power and duties of State inspector of gas meters in Greater New York, since which time the citizens of this metropolis have been protected by all manner of safeguards against the possibility of fraud. All meters are carefully tested by the Commission and must bear its seal before being placed in a building. This seal indicates that the meter, when tested, was correct or not more than 2 per cent slow. A slow meter is one that does not register the full amount of gas passing through it, while a fast meter makes the consumer pay for more gas than he uses. No meter is allowed to be placed on a consumer's premises that runs at all fast, but if on a complaint a meter is not more than 2 per cent fast it is passed as correct. For the absurdly small fee of 50 cents (this applies to the smaller meters, for the larger meters from 20 to 300 lights and upward the charge is from 75 cents to $2.00), any one in New York can have his meter tested, and if the meter is found to be running more than 2 per cent fast, not only is the fee refunded and charged to the gas company but the latter must make a settlement with the consumer for the unconsumed gas he has been paying for. From July, 1907, to July, 1911, 19,970 gas meters were tested on complaint, 45.8 per cent of these were found to be correct or within 2 per cent fast or slow, 10.3 per cent were found to be slow or running to the disadvantage of the gas company while 43.9 per cent were fast. The variation of the meters averaged a very small figure however, showing that the work of the meter itself was on the whole very creditable.

When a complaint is made to the Commission, a complaint inspector visits the consumer and makes a thorough inspection of his premises, searching for leaks. Occasionally a leak will be discovered near an open window or close to a chimney flue, where the draught will carry off the gas into the open, letting it escape undetected. Sometimes a jet is left burning in an attic or in some unused room such as an amateur photographer's dark room, and the tenant comes back after a month or two of vacation to find a gas bill awaiting him. Not infrequently in apartment houses the meter is found to be connected with the wrong apartment and one man is then paying the other man's bills. Troubles of this sort account for the running of the gas meter when no gas is used. As a matter of fact, the meter can register nothing if no gas passes through it. When satisfied that there is no trouble with the pipes, the meter inspector seals and tags the meter and has it removed to the testing station.

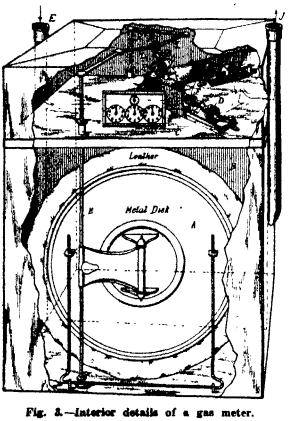


Fig. 3.—Interior details of a gas meter.

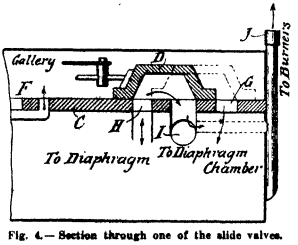


Fig. 4.—Section through one of the slide valves.

The manner of testing the meter is simple. A measured quantity of air is passed through the meter, and the two foot testing dial of the meter is noted, to see whether it registers this amount correctly. The prover in which the air or gas is contained is built just like a gasometer, consisting of a cylinder, with open bottom which telescopes within another cylinder filled with water to form a seal between the two. The inner cylinder is provided with a port which may be opened to admit air as it is raised. This port is then closed, sealing the air within as in a diving bell. The meter is now connected with the cylinder, and after care has been taken to make all the joints tight the air is allowed to pass out through the meter. When two cubic feet of air have passed through, as indicated by the small dial, an indicator on the prover should show that two cubic feet of air have actually issued from the cylinder. If over two per cent plus or minus is indicated, the meter is rejected and must go to the repair shop. Usually three readings are taken and the average of the three determines the condition of the meter, this precaution being observed so as to do away with the personal equation which might be a factor of serious importance if but a single reading were used.

If we follow the meter to the repair shop, we shall have a chance to investigate its interior construction and learn something of the ailments to which it is subject.

The drawing in Fig. 3 shows us how a meter would look if the front wall of the tin casing were torn off. Probably the first object to catch the eye would be the large circular bellows that occupies the lower part of the meter at *A*. There is another bellows of the same size and shape on the opposite side of the central vertical partition *B*. These bellows or "diaphragms," to use the technical name, consist of a ring of metal soldered to the partition *B* and connected by a strip of flexible leather to a metal disk. The diaphragms are the lungs of the



Reconstructing condemned meters.

THE METER

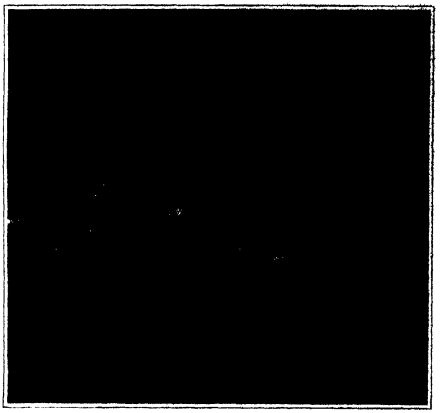
meter which inhale and exhale measured quantities of gas, while a counting mechanism is actuated by the heaving lungs, and indicates the count on the dials.

The counting mechanism is situated in the upper chamber or "gallery" formed by the horizontal partition C and here also are the slide valves D that admit the gas to the diaphragms. A somewhat diagrammatic section through one of these valves is shown in Fig. 4. Gas enters the meter through the tube E and flows into the valve chamber through the port F. The valve port G leads to one of the diaphragm compartments, while the port H leads to the interior of the diaphragm in that compartment. The outlet port is shown at I, and it leads through pipe J to the burners in the house. The valve D is shaped to provide communication between the outlet port I and one or other of the ports G and H at all times so that there is no interruption in the flow of gas out of the meter. With the valve in the position shown by full lines in Fig. 4, the gas is slowly filling the diaphragm chamber and flattening the diaphragm which in turn is exhaling the gas it contains by way of the ports H and I. When the valve moves to the position shown by dotted lines, gas enters the diaphragms through port H and, as the diaphragm expands, under the pressure of the mains, it causes a proportionate amount of gas to flow out of the chamber through ports G and I to the outlet J. As there are two sets of diaphragms and valves operating in alternation, there is no appreciable variation in the pressure of the outflowing gas.

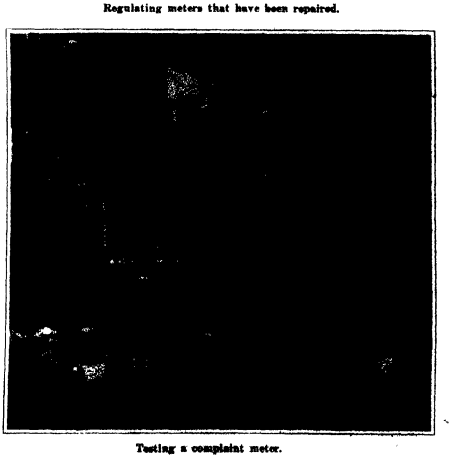
Each diaphragm is connected to a vertical rock shaft provided with a crank arm, and connected by a link L to a sleeve M adjustable on an arm N projecting from the valve shaft O. The combined motions of the rock shafts as they are oscillated by the inhaling and exhaling diaphragms, cause the valve shaft to rotate, and by means of connecting rods P to operate the valves. By means of a worm and gear R, the counting mechanism is operated. The dog S serves to prevent the mechanism from running backward, and it is the action of the arm N striking this dog that produces the clicking noise which may plainly be heard when gas is flowing through the meter. Adjustment of the meter is provided by sliding the sleeve M in or out upon the crank arm N.

It is not very reassuring to the consumer to know that the majority of troubles that affect the gas meter tend to make it run fast rather than slow. As the parts become loose with wear there is a tendency for them to run faster, and as the leather bellows are saturated with moisture condensed from the gas, they shrink and deliver less gas at each aspiration. Sometimes so much water collects in the meter case that it seriously hinders the opening and closing of the bellows and they operate only when partially filled. Here again the consumer loses.

There is another difficulty which should be considered, but which, however, can be overcome by a very simple device. Normally the pressure used in New York is "15 to 25 tenths" to use the trade expression, which is equivalent to about one-half to one pound water pressure, U or siphon gage measurement. If for instance, the pressure should be increased to, say, 40 tenths, 50 per cent more gas would be consumed at the burner and although there would be an increase in light, it would not be sufficient to compensate for the increase in the gas bill. On the other hand, the meter would not register the full amount of gas passing. There would be a loss of about 2 per cent which the company would have to stand for. To obviate this trouble, a governor is provided, which may be placed upon the service pipe before it enters the meter. This will hold the pressure down to the normal limit. There was a period, from 1907 to 1909, when the pressure in New York was confined by law between the limits of 15 and 25 tenths. This limitation was finally withdrawn on the representation of the gas companies who claimed that owing to friction when conducting gas over a long range, it is necessary to use a high initial pressure in order to maintain sufficient pressure at the end of the line. Still another factor to be considered is the elevation of the burner. The pressure at the crest of a hill is more than that in the valley below; on the ground floor of a skyscraper it would be much less than at the top. There is a difference of one-tenth pressure for every 14 feet of elevation, so that at the top of a 700-foot structure like the Metropolitan tower, twice as much gas would flow through a five-foot burner as at the street level. However, it is only in naked gas flames that there is a loss due to high pressure. Incandescent mantle lamps are self-governing and will consume only a fixed quantity of gas, while if the gas is used for cooking purposes there is no loss; for a rise in pressure will result in a corresponding rise in temperature.



Regulating meters that have been repaired.



Testing a complaint meter.

THE METER

The Burning of the German Military Dirigible "M III"

By Carl Dienstbach

THE crack dirigible of the Germany army, the semi-rigid "M III.," was partially destroyed by fire just before the end of the "Kaisermanoeuvers," in which it had rendered valuable services on the "red" side.

The circumstances of this accident are interesting and instructive. The "M III." was of the Gross-Basenach German semi-rigid system, which differs from the original French semi-rigid Lebaudy system in separating the gas bag from the stiffening frame, causing the latter part of the suspension, and dividing it into three separate sections better to withstand shocks in landing and facilitate dismantling. The envelope is similar to that of the Parseval system, having two ballonets fore and aft, with a distributing valve for the air between, to assist the vertical steering, which is done principally by shifting water with a pump between two tanks at the extremities of the combined stiffening frames. A seemingly slight, but as the accident has shown essential, defect was traced to the position of the blower for the ballonets. It is not carried in the car, but far above it, next to the frames, and driven by rope transmission to reduce the drag in the air of a long hose connection between car and envelope.

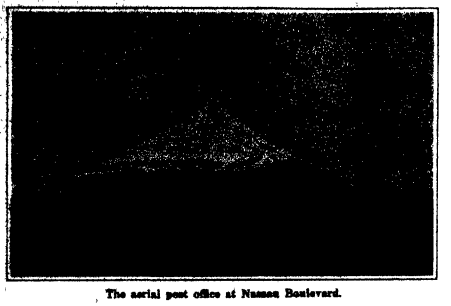
The "M III." displaced 240,000 cubic feet, had a length of 300 and a beam of 38 feet. The car was 40 feet long, and the distance between the bottom of the car and the top of the envelope stood 67 feet. The horse-power was 300, furnished by four Koerting motors, driving two propellers. The "M III." was equipped with wireless telegraph apparatus, and armed with apparatus for discharging explosives. In the maneuvers the whole crew of seven was furnished with rifles, kept in a special rack. Five of the crew were required to handle the ship, and two were observers. All but the engineers were army officers.

In this year's army maneuvers in Mecklenburg, Uckermark, and Pommerania, from September 7th to 14th, the "M III" had successfully performed all its allotted tasks, and, after ascending from Demming, Pommerania, in the morning of September 13th, was cruising in steady, certain flight over the villages of Golchen and Clempenow, when suddenly the rope transmission to the blower snapped. The gas bag began to lose its shape, and repairing in the air being not feasible on account of the blower's position, a landing became imperative. The dirigible was then drifting with useless motors toward a broad stretch of meadow on both banks of the Tollense River, a tributary of the Peene. From the air, in consequence of a well-known optical illusion, this meadow was apparently perfectly level and an excellent landing place. The pilot was evidently not an experienced airman, for he failed to recognize that the land formed a shallow valley, into and across which a lively "ground breese" was sweeping.

The descent, gentle at first, became suddenly very rapid when the airship caught in the descending current. The shock on striking the ground was quite violent. The ponderous envelope and framing continued to come down after the car had struck; fortunately, the wind carried it to the side of the car. From previous experiences with spherical balloons and investigations, it appears practically certain that the tremendous momentum of the heavy flabby mass of rubberised cloth of the gas bag and air ballonets, weighted with the framing and, in consequence of the quick descent, carrying a charge of atmospheric electricity, produced minute electric sparks through friction during this violent commotion; for the weather was very dry and hot. The shock at striking the ground also must have started leaks in the valves. The concussion instantly produced a certain quantity of explosive mixture of air and gas (normally the gas bag of a dirigible, unlike the envelope of a spherical, is hermetically sealed against the atmosphere by its safety valves), for there was a dull heavy report immediately after the envelope struck the ground, which shook the windows in the village of Gross below, and a column of flame shot up, which quickly consumed the gas bag with the planes, the framing, and the belly blower.

Fortunately, the crew could easily escape by jumping from the car on the opposite side, and the car with the motors and propellers was little harmed.

The accident is very instructive in showing how greatly the safety of a dirigible depends on the airmanship of the pilot, and that the facility to deflate and collapse, in place of being a guarantee of security, may, on the contrary, become a source of danger.



The aerial post office at Nassau Boulevard.



A card transmitted by aerial post.

Carrying Mail by Aeroplane

The First Experiments in this Country at the International Aviation Meet

ALTHOUGH the primal practical use of the aeroplane, as conceived by the Wright brothers, was for purposes of war, perhaps the regular carrying of mail will be the first actual use to which it will be put by our government.

The first experiments in carrying mail were made by the British government in India last winter, when mail was carried from the Allahabad exposition grounds to a point several miles distant. Early in the present month, an aerial postal service was maintained for about a week between Hendon (near London) and Windsor Castle. This is a distance of some twenty miles. The mail was carried with more or less regularity by three machines—two biplanes and a monoplane, piloted by Driver, Hubert, and Gregwell. The last named made the opening flight on his Blériot racer in a 25-mile wind, carrying letters sent by the King, Queen, and Postmaster-General to the Mikado and all the crowned heads of Europe.

On the opening day, 11,000 to 13,000 letters were carried, and all told, over 100,000 letters and postals were started on their way by the air route. It was in the maintaining of this mail service that Lieut. Cammell fell to his death. Strong winds delayed it on some of the days, but on the whole the service was maintained with commendable regularity.

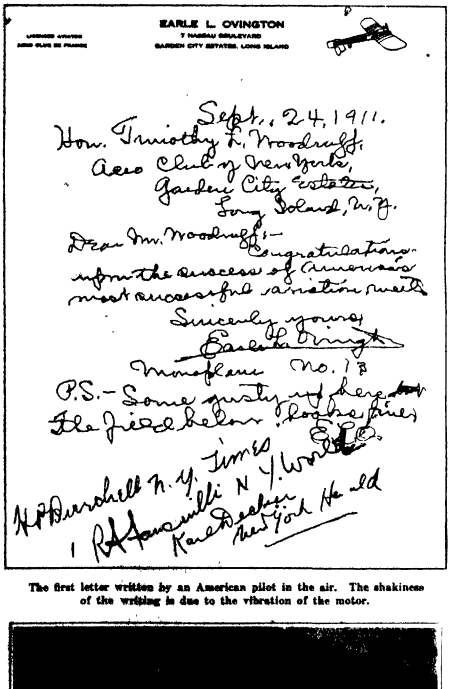
When it was decided to hold an aviation meet at the Nassau Boulevard Aerodrome, one of the first features determined upon was an aerial postal service to Brooklyn. Postmaster-General Hitchcock authorized this service, and so interested was he that he personally carried the mail on the fourth day of the meet.

About a score of letter boxes were placed around at different parts of the grounds. These were labeled "Aerial U. S. Mail," and two collections were made each afternoon. The mail was taken to a special tent, where it was stamped and assorted and placed in small bags containing from ten to fifteen or twenty pounds. Instead of carrying the mail to the outskirts of Brooklyn, it was taken a few miles farther away from New York to Mineola and dropped in a field at the feet of the postmaster, who was on hand to receive it at the appointed hour.

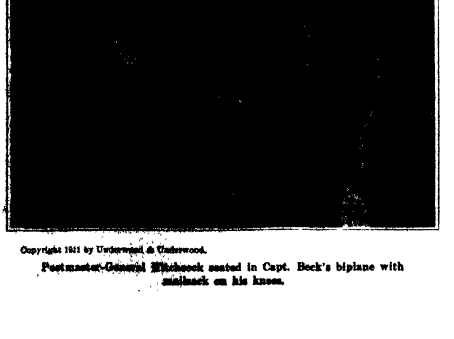
Starting on Saturday, September 23rd, Earle L. Ovington, in his Blériot monoplane, made regular deliveries twice a day. On Sunday, the big day of the meet, there were 6,165 post-cards, 731 letters, and 55 pieces of printed matter to be transported. One bag weighing 14 pounds was carried by Ovington, while another, which weighed about 20 pounds, was given to Capt. Beck to be taken in his Curtiss biplane. Capt. Beck had trouble with his motor, however, and the heavy bag was carried by Tom Sopwith in his Wright. On Tuesday when Postmaster-General Hitchcock himself carried the mail the pouch which he dropped overboard at Mineola contained 162 letters and 1,400 postal cards while the one carried by Ovington who showed him the way, had 300 letters and 2,200 postal cards, besides 78 other pieces of printed matter.

But one day during the meet was the mail service interrupted, which speaks well for the aeroplane as a regular mail carrier. Several days there was a strong wind, and two days it rained.

A demonstration of skillful airmanship was made by Mr. Ovington when he wrote a letter with a widely advertised fountain pen while aloft in his Blériot monoplane. Before ascending Ovington gave a blank sheet of paper to representatives of three New York newspapers, who wrote their names upon it so that they could identify it after the exploit and testify to the genuineness of the document. This letter is reproduced herewith, together with a postal card which was sent by aerial post. Ovington was able to write but once in a while, when the machine tipped sidewise, or tended to dive his pen would slip slightly. The vibration of the motor caused the irregular writing shown in our reproduction of his letter, but the fact that he could write at all while flying a fast monoplane, shows the control which he had over his machine. He operated his warping mechanism and horizontal tail rudder with his left hand while writing.



The first letter written by an American pilot in the air. The shakiness of the writing is due to the vibration of the motor.



Copyright 1911 by Underwood & Underwood.

Postmaster-General Hitchcock seated in Capt. Beck's biplane with mailsack on his knee.

It is to be hoped that the successful demonstration of mail-carrying that was given at the recent meet will cause the Postmaster-General further to consider the aeroplane for this use. It is quite possible to dispatch mail from New York to Boston or to Philadelphia and send it through without a stop. A gain of one or two hours could be made in the first instance and the establishment of the service between New York and Philadelphia would make it possible to send a letter in the morning at the opening of the business day and receive a reply early in the afternoon, whereupon a second letter could be forwarded and received before nightfall.

It is said arrangements are about to be made by transatlantic steamship companies for the special delivery of certain classes of foreign mail from the deck of the steamer as it approaches the coast to some station or locality in New York city by aeroplanes carried on the ship. By this means much quicker delivery could be effected.

Aeroplanes may yet be used for carrying messages or light life saving lines ashore from a stranded steamer when the distance from shore is beyond the range of the usual cannon.

The Diesel Engine

The Development of a Remarkable Motor

By Hayner H. Gordon

ANY one who has seen a large triple expansion marine engine in operation has been impressed with the mechanical beauty of the machine Light and powerful yet easy running, with complicated structure yet mechanically simple, it appears as though this type of engine had at last reached perfection And yet to-day it stands ready to be replaced by a new type of engine and motive power, a motive power that even a few years ago was largely ridiculed for its unreliability The gas engine is conquering the land, has conquered the air, and is now beginning to claim the sea for its own

All internal combustion engines are divisible into two general classes those in which combustion takes place at constant volume, and those in which combustion takes place at constant pressure, the first being known as the Otto type and the second as the Brayton or Diesel type

In order to make the difference between these two types clearer, it will be well to follow the cycle of operations in each case In the Otto four-cycle engine, the piston on the first stroke down draws in the combustible mixture. The up stroke then takes place, compressing the charge to a pressure limited by the ignition temperature of the charge used This is usually from 60 to 120 pounds per square inch, at the top of this stroke the charge is ignited, and the piston is driven down by the pressure generated by the explosion of the charge The fourth stroke then follows, the piston rising and the exhaust products passing out through the opened exhaust valve

In the Diesel cycle the first stroke of the piston draws pure air into the cylinder, the piston then rises, compressing the air to a pressure of 500 or 600 pounds to the square inch, and thereby raising its temperature to about 500 deg C This high pressure is obtained by having very small clearance At the top of the compression stroke an oil valve in the cylinder head is opened, and oil is forced into the cylinder in the form of a fine spray This is at once ignited from the highly heated air, and continues to burn until the oil is cut off at about one-quarter to one-third of the down stroke of the piston Expansion follows for the rest of the stroke, and the fourth stroke then takes place as in the Otto cycle

In the two-cycle engines of either class the piston uncovers ports at the end of its downward travel, the exhaust products passing out through one set of ports while the new charge is blown into the cylinder under slight pressure through the other ports The charge of course consists of combustible mixture in the Otto engine, and air in the Diesel engine Compression and working stroke then follow as in the case of the four-cycle engine

Three points of superiority of the Diesel engine over the Otto engine will at once be noted The first of these is the fact that there is no igniter present in the Diesel engine, and that therefore no ignition trouble can take place Also there will be no trouble from pre-ignition, for there is no fuel in the cylinder during the up stroke of the piston

The second point is that there is no carburetion or mixture troubles In an engine of the Otto type there is always a varying amount of exhaust products present in the mixture at various speeds which necessitates close regulation of the fuel supply In the Diesel engine the speed and power of the engine are entirely controlled by regulating the point in the working stroke at which the fuel is cut off The last point in favor of the Diesel engine is the fact that the change in pressure is not violent as is the case in the Otto engine, but gradually increases during the compression stroke, reaching the maximum at the end of the stroke and then remaining approximately constant until the fuel cut-off takes place

The cylinders of the Diesel engine are of small bore with a long stroke The pistons have to be well fitted in order to retain the high compression Sometimes as many as ten piston rings are used for this purpose

The fuels which may be used in the Diesel engine range from the lightest hydrocarbons to the heaviest crude oils As the fuel must be entirely atomized upon entrance to the cylinder, we find a great many different types of valves for the different grades of oil The valves are divisible, however into two general classes Those which make use of a fuel pump to force the fuel into the cylinder, and those which use compressed air to blow it in Valves of the first type comprise a small passage through the cylinder head with a needle valve to adjust the nozzle or spray and which opens into the cylinder Fuel is pumped to this spray valve by a small single acting plunger pump, at a pressure of 750 pounds per square inch, the length of stroke of the pump plunger being generally made adjustable, in order to time the admission of the fuel to the work of the engine.

The compressed air fuel admission valve is more largely used than the type just described. This valve usually consists of a hollow plug fitting in the cylinder head of the engine, and containing an inwardly opening check valve in the inner end. The hole in the center of this plug receives the charge of oil under a few pounds pressure, during the compression stroke of the engine, and then high pressure air at 750 pounds is admitted to the chambered plug, and the oil blown into the cylinder of the engine in the form of a fine

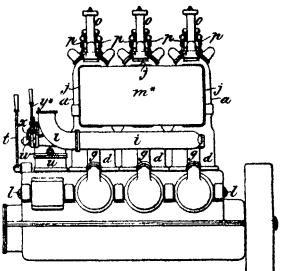


Fig. 1.—Reversing gear dependent upon changing position of cams relatively to the crank shaft.

spray. A valve of this type of course necessitates the use of a separate air compressor, but this is generally needed any way in order to furnish compressed air for starting the engine In order to start the engine by compressed air, there is an auxiliary starting air inlet valve, which is operated from a cam on the camshaft to admit the high pressure air on a portion of the working stroke of the engine, thereby running it as an ordinary air engine As soon as the engine picks up speed, the air valves are thrown out of operation by lifting the rockers off the cams or other equivalent method, and the engine picks up its regular cycle.

In addition to being equipped with self starting apparatus, the Diesel motor must also be made reversible, when used for marine purposes In the case of low

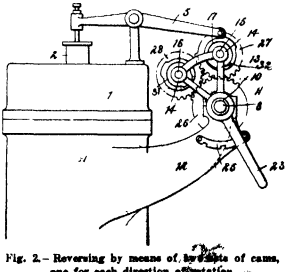


Fig. 2.—Reversing by means of, two sets of cams, one for each direction of rotation.

power and small engines, it is possible to use either a reverse clutch or a reversible propeller, but such practice is impossible in engines of a thousand horsepower or over

There are two methods employed in practice for reversing marine motors. The first is to change the angular position of the cams with respect to the crank shaft, and each other.

Fig 1 shows a small Diesel marine engine employing this method of reversing This engine possesses very unusual features in regard to the starting It is of the two-cycle type, with exhaust ports controlled by the piston, and possesses an air compressing cylinder for each engine cylinder. To start, compressed air from the air tanks is admitted to the pump cylinders, which act to drive the engine until it picks up its cycle. This engine employs two separate cam shafts, one operating the oil valves and the other driving the pumps. The adjustment of the shaft is made by means of sliding spiral gears which drive the cam shafts. These sliding spiral gears are controlled by the longer lever on the left hand end of the engine. The short lever controls the starting air.

The other method is to use two sets of cams, one set being used for each direction of rotation. These cams are sometimes placed on the same cam shaft, which is made longitudinally adjustable under the lifters. A modification makes use of two cam shafts, one for ahead and the other for astern. These shafts may be swung in position under the valve lifters. Such an arrangement is shown in Fig. 2

The reversing mechanism for the two-cycle engines is not quite so complicated as that for the four-cycle, the only valve mechanism necessary being that for the starting and fuel valves.

Probably the one feature of the Diesel motor which is causing its introduction into the marine field more than anything else, is its efficiency. Tests have been made on large engines of this type which show the almost remarkable figures of 0.38 pound of fuel used per brake horse-power hour. This is for crude oil. The marine engines of this type now in use average from 0.40 to 0.44 pound of fuel per brake horse-power hour while running under full load. When we compare these figures with those of the best triple expansion marine engines, which burn 1.46 pounds of coal per brake horse-power hour, we at once see the great advantage of the Diesel engine. In round figures, the Diesel engine will drive a ship just as fast and just as far on 100 tons of fuel, as a steam engine would on 350 tons of coal Moreover, the liquid fuel may be stored in tanks placed in the double bottom of the ship; thereby giving space formerly occupied by the boilers and coal bunkers, over to passenger and cargo space The earning power of the ship is thereby increased; the engine room space needed for an oil engine is just about the same as the engine room needed for the steam engine equipment.

The accessories needed for the Diesel engine require about the same space as the condenser and pumps of the steam engine

The construction of the marine oil engine seems to follow along the standard lines laid down by steam engine practice; all the large oil engines so far constructed have a short piston and use flat guides, and a cross head with the ordinary open construction It has been stated that it is poor practice to use the trunk piston, on account of the slight longitudinal movement of the crank shaft as the thrust bearings wear With flat guides this slight play would make no difference, and the open construction also renders inspection easier.

The air pump for obtaining air for starting, and for fuel injection purposes, is generally obtained from a three-stage air compressor, which is driven from the cross heads of the three cylinders, air being cooled between the compressor stages The circulation pumps are also driven from the main engine; but an auxiliary air compressor and auxiliary circulation pumps driven by smaller oil engines are provided for breakdown purposes. The bilge and fire pumps are either electrically driven, or driven by a separate engine, and electric current for light and power purposes is provided by direct-coupled generators driven by oil engines.

The oil engines in use at the present time—and building—comprise both two and four-cycle single and double acting Each type has many good features of its own and it is almost too early to state which is the better; the construction of the two-cycle, double-acting engine is complicated, but the number of cylinders is reduced for a given power. On the other hand, in an engine with eight cylinders, one cylinder may not become inoperative without affecting the power of the engine to a very great extent.

It is safe to say that the development of the oil engine in this new role will proceed rapidly. With several German firms building large vessels equipped with oil engines, with the report that the German Admiralty is building a cruiser to be equipped with two six-cylinder engines each of 8,000 horse-power, and with several Glasgow firms building vessels similarly equipped, we shall soon see the oil engine given ample trials.

Correspondence

[The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.]

Revival of the Merchant Marine

To the Editor of the SCIENTIFIC AMERICAN:

I write to express my high appreciation of the great interest which since April 1st you have been manifesting in the upbuilding of the American merchant marine.

Everything published on this subject, either in your editorial or your correspondence columns, is greedily devoured by this writer, who for the past twelve years has made a special study of ship subsidy, mail subsidy, postal subvention, preferential duties, free ships, and every other measure suggested by human ingenuity for restoring that branch of our merchant marine engaged in the foreign or deep-sea trade to the proud position it formerly occupied.

The greatest difficulty in doing this seems to be in getting people living in the interior of the continent, remote from the seaboard, to take an interest in or to inform themselves on such matters.

The writer bids you Godspeed in the work you propose to undertake. JAMES G MCBRIDE.

Canten, Miss.

One Man Who Saw the Meteor Train

To the Editor of the SCIENTIFIC AMERICAN.

Regarding the letter on your page 275 *re* "Meteor Train," I was one of a party of about a dozen at Mamaronsck, New York, who saw the appearance substantially as described by Mr. Pfarre.

Philadelphia, Pa. EDWARD T CHILD.

Lessons of the Gordon Bennett Flying Race

To the Editor of the SCIENTIFIC AMERICAN

With reference to the above subject in your issue of August 19th, will you kindly permit a few supplementary remarks in concurrence with Mr Grover Loening's views thereon? Your contributor lays particular stress upon the difficulty experienced by such able exponents as Weymann and Leblanc in turning sharply at each pylon, and emphasizes on the other hand the facility and also marvelous "banking" performed by Ogilvie on the "Baby Wright."

Now it is certainly correct that this feat is difficult at all times with such superficial area out of all proportion in the case of the 40 square feet surface of the clipped Blériot, but it is also equally certain that the centrifugal force generated by the single tractor-screw is a factor not to be overlooked. That of the Nieuport was 7 feet diameter, the Blériot 8½ feet, while the twin propellers of the Wright are 8¼ feet each, the last however revolving in opposite directions and thus counteracting centrifugal action magnified in the monoplanes. Consequently, the Wright—or its equivalent, a monoplane with twin propellers—is able to "bank" acutely in negotiating turns which would necessitate wide curves with the single-screw type or an alternative loss of stability and disaster. A still further point of importance with monoplanes driven by twin screws is the greater velocity attainable over the biplane similarly propelled, with furthermore the facility to forge against stronger winds—a real desideratum

It is really extraordinary to note at the present moment the continuous copying universally of the Wrights' patent warping system, either flagrantly emulating the bending of the rear marginal tips in conjunction with the foot-operated vertical rudder, or the virtual reproduction of the same by means of ailerons —a system which although copied from nature is by no means the most powerful in controlling lateral stability by the bird. That perfect aviator among other methods demonstrates to us that by warping, or rather *depressing*, the outer half of one wing and correspondingly elevating the othe , he obviates all danger of law litigation by encroaching on the Wright patent!

Well might Mr. Grover Loening in his able article refer to the emphasizing for the need of the "variable surface" monoplane shown by the Gordon Bennett race. Not only will greater speed be accomplished by the adoption of the bird-like wing, but so will inherent or natural stability be automatically secured in tumultuous winds by means of flexible construction in addition to this urgent need for variable surface. Therefore, the lessons demonstrated not only by the Gordon Bennett flying race, but by daily flights throughout the globe, for the production and evolution of the ideal mechanical flying machine, may be succinctly summarised in the following requirements: (1) The improvement of the car or fuselage in finer stream-line Nieuport form; (2) twin propellers of large diameter to thus engage a larger volume of air or "disk area," and rotating in opposite directions to minimise undue centrifugal force; (3) constructing the main planes flexible with small camber, high aspect ratio, and single-surfaced; (4) by superior lateral control other than that employed in the biplane of the Wrights and assured by the graduating of main spars toward the tips; (5) by variable surfacing of main planes or wings to insure higher speeds and susceptibility to encounter safely higher wind velocities by such diminution and augmentation of the supporting area, (6) the discarding of the vertical rudder acting in conjunction with the main planes for steering in the horizontal plane; (7) the need for compactly folding the wings against the side of a car when not in use or descent on water; (8) and the means for increasing or decreasing the angle of incidence of the main planes to suit the requirements of flight conditions All the above essential features are by no means impossible to reproduce in one design, and will decidedly enable a monoplane to ascend and descend from water, and in due course to fly across the Atlantic

London, England. EDGAR E WILSON

The Proposed Safety Stop Locomotive Throttle

To the Editor of the SCIENTIFIC AMERICAN

In the correspondence department of your issue dated August 19th, on page 167, I noticed an article by Aubrey D. Beldelman, of Braintree, Mass., headed "The Bridgeport Railroad Wreck"

In the last paragraph of his communication he offers the suggestion that the throttle and brake-valve handle be provided with means to automatically bring them to positions that would shut off the steam and apply the brakes in the event of the engineer's becoming incapacitated from any cause To quote from his article, "it would be necessary for the engineer to exert some little pressure on them" to prevent their action in this manner

He questions if a device of this kind would be inconvenient. To my mind it would be insufferably so In traversing a rolling country it is necessary for the engineman to frequently change the position of the reverse lever, requiring the use of at least one and usually both hands It is at times necessary for him to use the injector on his side of the engine, due to the inability of the injector on the fireman's side to deliver sufficient water to the boiler

It is not an unheard of thing for an engineman to find it necessary to fill the lubricator while on the road

All these things take time; and while he was at tending to them, the steam would be shut off and the brakes applied, causing a considerable and undesirable reduction in speed

In addition to his physical duties, he has to keep in mind the orders he has received, which govern his movements with respect to other trains that may be on the road, their meeting and passing points, and what time he has in which to make a given point before another train This would be extremely difficult for a man under the continuous physical strain that would be required to maintain these two levers in running position, especially in the case of the throttle as he would have to exert considerable force to hold it open against a device that would have any value as a positive closing mechanism

The conditions under which an engineman works at present are not what might be termed restful There is continual jar and pound, as a locomotive compared to a coach rides about as easily as a hay wagon compared to a limousine

If in addition to this a man were compelled to maintain a steady and unremitting pressure for a period of from three to seven hours, the average length of a passenger run, it would be almost if not quite beyond human endurance.

Los Angeles, Cal. J B WELLS

Irrigation Supplementing Water Power

A New Joint Use for Our Canals.

To the Editor of the SCIENTIFIC AMERICAN

In order to get at the power to be obtained from waterfalls, a height of 10 available feet is taken as a convenient basis to calculate any power from

One cubic foot of water, weight 62½ pounds, falling 10 feet produces 625 foot pounds Requirement for one horse-power, 33,000 pounds divided by 625, gives 53.8 cubic feet, required, for one theoretical horse-power, per minute.

But as wheel efficiency is seldom over 75 per cent, we add one-third to 52.8 or 70.4 cubic feet of water, which is sufficient to cover 844 square feet, or one-fifty-second of an acre So that the amount of water required to produce one horse-power 52 minutes would cover one acre one inch deep, if none was wasted. But as the waste is considerable, let us assume that it requires two hours to cover one acre one inch, or in ten hours the water required to yield one horse-power would cover five acres one inch deep.

Now, as power can be generated, even in small units, for not over 20 cents per horse-power for ten hours, and in large units for much less, we have one inch of water costing four cents per acre, when for some crops it would be worth easily fifty times that, and others much more, as this water is warm rain water, and far superior to well water for irrigation purposes

In view of the above statements, can we not safely conclude that our canals, or at least such sections of them as are favorably located should be maintained for irrigation, which as explained below, may also reduce their value for water powers but little?

In many cases the canal is so located that all the water to be spared can naturally flow onto the lands, while in some cases a ditch to the next lock may be required to get the water high enough

The very favorable results of some small irrigating experiments in our section, I think, will fully justify our valuable experiment stations in examining available located lands, and in preparing necessary information as to suitable crops, fertilizers, sand mixing to lighten heavy soils, etc That may enable the great increase in crops due to irrigating to be fully realized

Now, if the power man, who is usually short of power, either for manufacturing or to sell electrically, will arrange his water wheels, etc, so as to give him the full power of the fall for say the best six months of the year, and will put in engines enough to develop the same amount of power, to be used when there is not water enough for all needed, which if for lighting will be less when water is lowest, he can have water power for all his needs for six months or more, and for nearly all the rest of the time part of the water, in fact most of it Where the water is used only for ten hours for power, the irrigating can be done at night, as in the West So that the power man can be in a better position, after the first cost of engine installment is paid than if entirely dependent on the water power, as he will not only have increased power, but also power that can absolutely be depended on

I trust that the above will be in some way, a suggestion that will be a benefit to the community and the State in making use of its canals

Dayton, O J H STEVENS

Automatic Stability in Aeroplanes—A Suggestion

To the Editor of the SCIENTIFIC AMERICAN

Would you allow me to express through your valuable paper my opinion on the possible solution of the automatic lateral stability in flying machines?

The many devices designed and tried out to maintain automatic stability have as yet not met with the success which would be desirous All further progress and the commercialization of aerial navigation depend upon the appearance of such a device A suggestion of my own may lead to a possible solution of this problem I describe my idea with a view of encouraging constructors of flying machines to experiment in this direction

My automatic lateral stabilizer consists of fins, constructed of a light framework of wood or metal covered with a suitable fabric These fins are hinged under the surface, at the extreme ends of the plane (wing tips) and can swing to both sides When swinging inward such a fin can move until it lies flat under the surface, but toward the outward it is prevented by a strap from swinging farther than 45 degrees

The function of the device may be conceived to be as follows

When the plane is in motion, and as long as it is not influenced by a force caused by a side wind, the fins will be retained in a vertical position But when the wind strikes the plane at an angle to the direction of motion, the fin nearest to the side from which the wind is coming will be laid flat under the surface of the plane At the same time the fin on the opposite side swings outward to an angle of 45 degrees to the plane, and will present a resistance corresponding to the natural resistance on the windward side

This arrangement seemingly works well when straight flights are made, and even in turning it seems likely to do all the banking required, but to straighten out the aeroplane after or at the termination of the turn, it may be found necessary to have recourse to the operation of ailerons Even if this device needs at times to be supplemented by ailerons it would do much to relieve the operator of an aeroplane of the continuous strain which the attendance of a lever mechanism to operate the lateral and the longitudinal stability means

One of the main requirements would be to have the size of the fins in the right proportion to the plane which it serves as equalizer

Such a device could be used on aeroplanes of all constructions, and to simplify the attachment of these fins the last five or six ribs on both sides should flatten out gradually, so as to make the extreme ends of the plane nearly flat.

Chicago, Ill. EWALD STEINHAUS

Filling a 400,000 Cubic-foot Balloon

Hydrogen-generating Plant for Vaniman's Transatlantic Expedition

WHO would ever suppose that such coarse, heavy stuff as rusty barrel hoops, iron filings and chips, lathe turnings, and other scraps of the machine shop would enter into the manufacture of the most tenuous and imponderable substance on earth? Of course the initiated know that hydrogen may be made by treating iron with sulphuric acid, and that this is the way that the gas with which balloons are inflated is commonly made. It is the sulphuric acid that contains the hydrogen, the iron serves merely to take up the sulphur and oxygen that form the bulk of the acid, thus liberating the hydrogen. Since in sulphuric acid there is but one part by weight of hydrogen to forty-eight of sulphur and oxygen, a large quantity of acid is required to produce enough hydrogen for an ordinary balloon; and when it comes to such huge airships as the "Akron" with which Mr. Vaniman intends to attempt a transatlantic flight this fall the amount of acid required is enormous. The gas bag of the "Akron" is 258 feet long, and 47 feet in diameter, with a capacity of 400,000 cubic feet. As the average street blocks of New York measure 250 feet and the width of Broadway downtown is but 40 feet from curb to curb, some idea of the huge bulk of the balloon can be obtained. To fill this huge gas bag a large plant was built at Atlantic City. Nearly 80 tons of scrap iron was carted to the plant and 100 tons of sulphuric acid in large casks, containing over 16,000 pounds each. These materials were capable of producing 450,000 cubic feet of hydrogen gas. An equal quantity of coal gas would supply an average town of 10,000 inhabitants for three days and if the gas were fed to an ordinary five-foot gas burner, it would take more than ten years to exhaust the supply. For five days and nights the plant operated continuously generating hydrogen, which was carried directly into the huge gas bag.

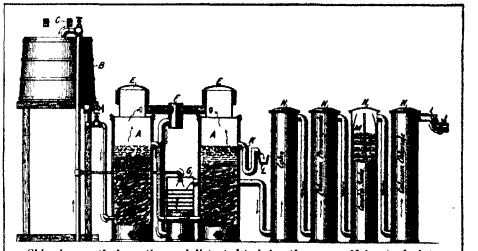
The bag is made of three thicknesses of cotton cloth, gummed together with thin layers of rubber, and its total weight is considerably over two tons. This, of course, is the weight of the bag in air when not inflated. It is always confusing to speak of weights when referring to a balloon. It is difficult to conceive that the hydrogen in the balloon has any weight, and yet if the balloon were in a vacuum it would crash to earth with a tremendous impact, for not only does the envelope weigh many thousand pounds, but the gas itself would weigh over a ton.

The accompanying drawings, which are somewhat diagrammatical, will serve to illustrate the process of producing the gas for the "Akron." One is a true plan view of the plant, and the other a distorted elevation, partly in section.

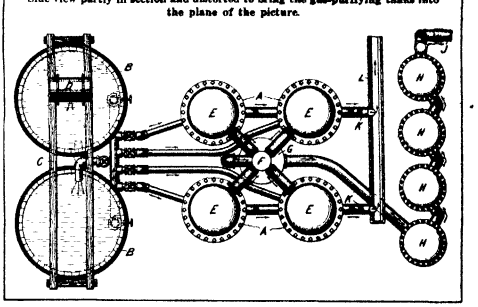
Those who are acquainted with the usual methods of generating hydrogen for balloons will notice a number of innovations introduced by Mr. Vaniman, whereby there is no interruption in the generation of the gas. As indicated in the plan view, there are four generator tanks *A*, which are made of wood with all the iron parts well coated with pitch to prevent the sulphuric acid from attacking them. These tanks are partly filled with scrap iron. The sulphuric acid is fed into the tanks from one of two large reservoirs *B*. Over the reservoirs is a track *C* on which the sulphuric acid cranks *D* are supported. In order to prevent too rapid a generation of gas and choking of the tanks with ferrous sulphate, the sulphuric acid is diluted.

For every part of sulphuric acid, eleven parts of water are used. While this mixture is being prepared in one of the reservoirs the other is tapped and the dilute sulphuric acid takes the course indicated by the arrows to the bottom of the generator tanks. It may flow directly into any one of these tanks or may be made to flow from one pair of tanks into the other. The latter is the more economical method, as it ensures complete action of every particle of the acid. The gas generated in the tanks rises to the top, where it is trapped by gasometers *E*, and flowing into a common chamber *F*, passes down to the washer *G*. Here it is forced to make its way upward through a series of perforated plates, while a spray of water flows downward through the same plates. Thence the gas passes through four tanks *H*, the first containing coke, the second potassium permanganate, the third caustic soda, and the fourth calcium chloride. The first two serve to purify the gas of such materials as arsenic, sulphur and phosphorus, which are apt to be picked up from the iron. The other two tanks serve to remove all traces of moisture from the gas.

Hydrogen is an odorless, colorless gas, and it would be impossible to detect leaks in the balloon were not some means used to impart an odor to the gas. The "perfume" commonly used is muronine. This is placed in a sponge as indicated at *I*, and thence the gas is fed directly into the balloon through the tube *J*. The "perfume" used has a most penetrating sickish odor, that can readily be detected, no matter how small the perforation in the bag through which the gas is escaping.



Side view partly in section and distorted to bring the gas-purifying tanks into the plane of the picture.



Plan view of the hydrogen-generating plant; course of liquid shown by straight arrow, course of gas by crooked arrows.

One of the advantages of the arrangement shown in the drawing is that when it is desired to charge one of the generators with fresh scrap iron it may be cut out of the system completely by turning off the pipe conducting the sulphuric acid to it and also placing a clamp on the rubber hose connecting the gasometer of that particular generator with the chamber *F*. The spent liquor flows from the generators through traps *K* to a trough *L*, which leads to a large trench or drain.

Heretofore the purifying and drying tanks have been filled with coke in which the various cleansing chemicals were sprinkled, the purpose of the coke being to prevent the materials from clogging. This method has caused much trouble because the materials would slowly gravitate to the bottom of the tanks, choking the flow of gas. Whenever such a condition arose, it was necessary to shut down the entire plant and clean out the tanks. Mr. Vaniman has adopted a different method. He uses a set of trays of copper netting secured to iron straps, as indicated at *M* in the drawing, and on these trays the purifying and drying materials are placed. Thus the mass is kept in a porous condition, through which the gas can easily percolate, and in case of any trouble the entire set of trays can be lifted out bodily.

The Trade Winds of Porto Rico

DR. O. L. FASSIG, of the United States Weather Bureau, is one of America's few able climatographers, and is well known for his exhaustive treatises on the climate of Maryland and of the city of Baltimore. For the past two years he has had charge of the Weather Bureau station at San Juan, Porto Rico, and he has of late published a number of useful and timely monographs on Porto Rican climate. The latest, which appears in the *Monthly Weather Review*, deals with the trade winds.

Although the trade winds of the northern hemisphere are commonly supposed to blow from the northeast, this is hardly their prevailing direction in the West Indies. In Porto Rico their general direction, taking the year as a whole, is between east and southeast, though the percentage of northeast winds increases during the winter. As to diurnal variations, the prevailing direction during the daytime (9 A. M. to 10 P. M.) is east, while during the night, after 10 o'clock, it is southeast. This applies to the year as a whole, but during July and August the prevailing east wind extends far into the night; viz., to 1 or 2 o'clock in the morning.

The average hourly velocity of the trade winds for the year is a little under 11 miles, the monthly values ranging from 8 miles an hour in October to 13 miles in July. On an average these winds are lightest about sunrise and strongest about 2 o'clock, at San Juan. The trade winds of course never rise to the force of a gale, and the few high winds that occur in Porto Rico are generally due to the passage of tropical cyclones.

Judging from the movement of clouds over San Juan, the average depth of the trade-wind current in this region probably does not exceed 10,000 feet. The upper clouds—the cirrus forms—have a nearly uniform movement from the western quadrant; that is, they show that the upper air current is opposite in direction to the trades.

The trade winds contribute greatly to the good health and comfort of the inhabitants of Porto Rico. In fact, it is the presence of the steady, moderate flow of the trades that takes this island out of the class of areas in the tropics to be avoided by white men, and makes it for more than half the year a very desirable place of residence for business as well as for pleasure.

The utilization of the trade winds as a source of motive power is gradually receiving proper recognition, and the number of wind-mills is increasing. The south side of the island is comparatively dry, and the rainfall is irregularly distributed through the year, necessitating extensive irrigation operations; while on the north side the drainage problem is almost equally important. In both these operations wind-driven pumps might be used to great advantage.

Nature's Parachutes

CAREFUL examination has been made of the heads of Canada thistle-downs, in order to determine their effectiveness as parachutes, carrying the seeds of the plant to great distances through the air. The results of this examination are quite remarkable.

Calculation shows that a thistle-down starting from an elevation of 10 feet, in still air, would require two-thirds of a minute to reach the ground. With a wind blowing 30 miles an hour it would be carried, on the average, about a fifth of a mile. The total surface exposed to the air in an average thistle-down is, on account of the great number of bristles, a little more than one-third of a square foot. Another well-known and very beautiful example of nature's parachutes is furnished by the light silken threads with the aid of which the little gossamer spider makes long aerial voyages.

Suggestions for the Workshop

Ingenious Expedients of Resourceful Mechanics

Handy Man's Medicine Chest

To the Editor of the Workshop Department:

In looking over Handy Man's Medicine Chest, in the issue of September 9th, I notice that the collodion dressing with aristol or iodoform added calls for 50 grains to the ounce. I intended this to read 50 grains. This amount would do more harm, but as there are only 31.1 grammes to the ounce, by using 50 grammes of aristol you have more aristol than collodion, which I fear would be an almost useless mixture. The mistake of reading grams for grains is often made by druggists, and for this reason I believe that when grammes is intended, it should be written out in full (grammes).

WILLIAM R. INGHAM, M.D.

Dangers of Gasoline Vapor Cleaning

To the Editor of the Workshop Department:

The description of an automobile cleaning device published among the "Suggestions for the Workshop," on page 276 of September 23d issue, is of considerable interest from an insurance point of view, from the fact that *the vapor from one pint of gasoline will make 200 cubic feet of air explosive*. The device seems to be an excellent gas generator; a flame some distance away will ignite the vapor, and the operator of the cleaner will never know what hit him.

Would it not be well to caution your readers against the use of such a dangerous machine?

F. D. C STEWARD.

Holder for Filing Small Screws

By R. F. D.

WHEN a small screw is to be filed down to shorten it, it is not advisable to put it in a vise for fear of damaging the threads.



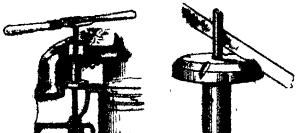
Holder for filing small screws.

A small piece of soft iron may be bent and drilled in the manner shown in the illustration, and then screwed or nailed to the bench top with the screw in the position shown.

Refacing Valve Seats

By Albert F. Bishop

WHEN refacing the valve seats of an automobile engine, it is usually the practice to make a reamer out of cast steel and temper and grind it to size. This is rather a tedious task and somewhat expensive. Recently a friend of the writer found it necessary to reface the valve seats of his four-cylinder automobile engine, which meant that there were eight valves to be treated. Instead of adopting the usual method, the writer suggested that he make his reamer of soft steel, and fit it with cutting edges by sawing through the beveled edge of the reamer with a hack saw in four places and driving in four pieces of clock spring. These cutters were filed down nearly



Reamer for regrinding valve seats.

to the surface of the reamer. The bevel was finished in the lathe with the grinder, allowing the clock spring strips to project about 0.02 of an inch, or less, from the surface. Small grooves were filed in the reamer in front of the cutting edges to allow for clearance of chips. The lower end of the reamer was made to fit nicely in the guide for the valve seat. One of the rings in the engine directly over the valve was bored out to fit the upper part of the reamer. This plug not only held the reamer accurately, but also acted as a stop, for it could be screwed down as the reamer was lowered. The eight seats were refaced with perfect ease, the last one cutting as well as the others. When the work was completed, the hole bored in the plug was stopped up with a piece of metal, and the plug was replaced in the engine for service. The valves were placed in the lathe and faced off enough to true them, after which they were inserted in the engine and ground to a fit with powdered glass and oil.

Laying Out Work for Drilling

By George F. Brown

A QUICK and accurate way of obtaining an impression of the holes already drilled in a flange when a new flange or cap is to be fitted to it, is to rub a piece of chalk down into the hole so that the edge will scrape off a small amount, forming a bead of chalk that is slightly raised above the surface of the flange. On the flange thus prepared the new flange is laid in



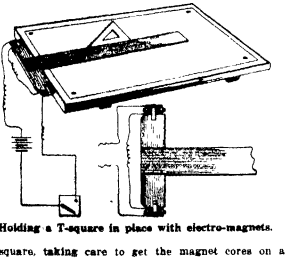
Laying out work for drilling.

the exact position in which it is to be bolted. On removing the chalked flange an accurate tracing of each hole will be found on the new flange. These circular tracings can be centered and drilled and they will be sure to mate the holes in the other flange when it is replaced for bolting.

Magnetic T-Square

By William Grötzinger

WHEN much hatching is to be done there is always a tendency to move the T-square out of position because it is necessary to hold the T-square and at the same time to manipulate the triangle and the ruling pen. To eliminate this trouble the writer took two small electro-magnets out of an old door bell, and fastened one on each end of the head of the



Holding a T-square in place with electro-magnets.

T-square, taking care to get the magnet cores on a line with the edge of the head.

Then a piece of thin iron band was fastened to the edge of the drawing board with several small screws. The magnets were connected in series with a battery and switch. When turning on the current, the magnets will hold the T-square firmly against the drawing board. Then all one needs to do is to attend to the triangle and the pen. This will eliminate slipping of the T-square and make for accurate work.

Flywheel Brake

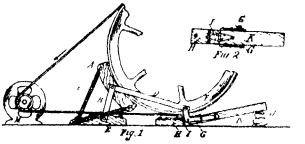
By C. M. Moon

THE brake illustrated herewith was designed for use on the flywheel of a heavy Gordon job printing press, having the driving motor belted to the flywheel. It was necessary to construct the brake in such a way that the parts would not interfere with the driving belt.

As will be seen by referring to the illustration, *M* represents the motor; *A* is the brake shoe, which is supported by two legs, *B*, with the belt passing between them. These legs are bolted to the block *E* which is securely fastened to the floor. The coil springs *C* assist in holding the brake shoe away from the wheel, and also keep the ends of the shoe from rubbing. The brake shoe is connected by means of two drawbars *D*, one on either side, with the two bell cranks *G* which are screwed to the sides of the foot lever *K*. These bell cranks, drawbars, and brake shoe legs are made from ⅝ inch band iron, ¼ inch thick.

The foot lever is connected with the block *H* by means of a 6-inch strap hinge *I*, as will be noted in Fig. 2 of the sketch, and the block *H* is securely fastened to the floor with lag screws. The coil spring *J* holds the outer end of the foot lever about three inches above the floor, and also assists in holding the brake shoe away from the flywheel, except when stopping the machine. The spring used was an old-fashioned bed spring, which answers the purpose very well.

The brake shoe, foot lever, and floor blocks should



Flywheel brake.

be made of hard wood if possible, but any kind will do the work. If desired, the shoe may be faced with a piece of leather belting, smooth side outward, which gives it a much better grip on the wheel.

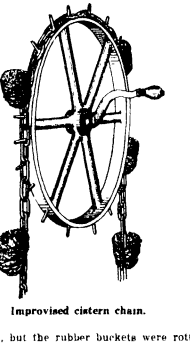
This brake is very powerful on account of the leverage obtained at the foot lever, and also because of the fact that the brake-shoe legs are not placed perpendicularly, but incline somewhat toward the flywheel, thus when the brake is applied, the friction tends to force the shoe more tightly under the wheel.

With this device the machine may be brought to a stop slowly, or in case of accident almost instantly, by increasing the pressure upon the foot lever.

Repairs to a Cistern

By J. W. Romig

A FRIEND of mine has a traction engine and one day while on the road he found that he had very little water left. Just at this time they were passing an old deserted house whose cistern was about half



Improvised cistern chain.

full of water, but the rubber buckets were rotted off, so taking some cotton waste from the engine he made buckets with this, and got enough water to complete his run.

Workshop Notes

To Sharpen Chisels.—Often one has chisels of awkward shape, and no stone with which to sharpen them. If a piece of wood is cut to fit the chisel, it can be used in place of a stone, by dipping it in a mixture of oil and powdered emery, and then manipulating as an ordinary stone.—B. FRANCIS DASHIELL.

Soldering Galvanized Iron.—Raw soldering fluid is generally used on the soldering copper when it is desired to solder galvanized iron. However, before commencing to solder, it is desirable to dip the soldering copper while hot in a solution of salammoniac and water. This will retain the tin on the point of the soldering copper, which would otherwise soon disappear.—A. F. B.

Disposition of Guns in Dreadnoughts

Foreign Navies are Adopting the American Center-line Plan

By Percival A. Hislam

With total number of ships of the all-big-gun type now built, building, or provided for in the current year, is exactly one hundred Great Britain leads with thirty-two (which includes two cruisers building at the cost of Australia and New Zealand), followed by Germany with twenty-one, and the United States with twelve. Japan, having this year placed orders for no fewer than five ships of the type (one building in England and four to be laid down in Japan), has increased her total to seven Russia, France, Italy and Austria have four ships apiece, none being yet completed, and the first named power proposes as soon as possible to raise her total to twelve Brazil and Spain each possesses three "Dreadnoughts," two of the Brazilian ones being completed, and the list is completed by the Argentine Republic, with two ships on the stocks, Turkey with two recently ordered in England, and Chili with two which are shortly to be placed out to contract

In this total of a hundred ships there are thirty one whose details either have not yet been decided upon or are not yet known The policy of secrecy, inaugurated by Great Britain with her pioneer "Dreadnought," has been followed by several other powers Germany conceals the particulars of her new warships very successfully, and only nine can be spoken of with any certainty. Latterly, Great Britain has relaxed the policy and the only vessels whose details are uncertain are the five of the 1911 12 programme Nothing is known of this year's quintet of Japanese ships except that they will carry 13.5 inch guns, and other ships where similar lack of certain knowledge exists are the new American vessels to be laid down this year (which, it is expected, will have ten 14-inch guns in two twin and two triple turrets), the last two of the four Austrian vessels, the Turkish and Chilian ships, and the Brazilian "Rio de Janeiro" The last-named vessel was for some time reported to be designed to carry twelve 14.5-inch, fourteen 6 inch, and fourteen 4-inch guns but it has latterly been stated that she will after all be no more than a replica of the "Minas Geraes" and "Sao Paolo"

In the case of the sixty-nine ships whose principal details are known, there is a very wide divergence in the mounting of the main battery This would necessarily follow from the fact that some are armed with eight, some with ten, some with twelve, and three even with thirteen heavy guns, but there are also considerable differences even among ships with the same number of guns

The first "Dreadnought" to be laid down and completed—the British ship of that name—has ten 12-inch guns so arranged as to produce a broadside efficiency of 80 per cent (Fig 10) Three turrets are on the center line and so can bear on either beam, but the other two are placed abreast on the beams, so that each can bear on only one broadside In a broadside engagement, therefore, two guns out of ten would be useless In spite of the obvious drawbacks of the arrangement, however, it was repeated in six later ships—"Bellerophon" "Temeraire," "Superb," "St Vincent," "Collingwood" and "Vanguard", and the result is that these seven ships, if they formed one battle unit, would have no fewer than fourteen 12-inch guns out of seventy useless for a line-ahead action

These seven British ships are the only five-turreted dreadnoughts which cannot dispose 100 per cent of their heavy guns on the beam The American five-turreted ships "Delaware" "North Dakota," "Florida," and "Utah" (Fig 6) have all their turrets on the middle line, with the result that these four ships, mounting ten 12 inch guns apiece and forty in all, are equal in broadside action to five of the British ships mounting fifty 12 inch guns, since only forty of these could be brought to bear on the beam We are not dealing here with secondary batteries; but the best five of these seven British ships mount ninety-two 4-inch all told (twenty each in the "St Vincents," and sixteen in the "Bellerophons"), while the four American vessels have sixty 5-inch, which, allowing for the much greater power of the 5-inch gun, is in all probability a superior equipment. In her later vessels Great Britain began to show signs of being influenced by the full-broadside argument. Its force was, however, admitted grudgingly, and a wavering effort made to combine a full broadside with a heavy fore and aft fire The "Neptune," "Hercules," and "Colossus" were the result (Fig. 9). These ships, like the earlier "Dreadnoughts," have three turrets on the middle line, but the wing pair are placed *e. échelon* across the deck amidships, while the last turret but one from aft is super-posed to fire over the aftermost The result is that six guns can be fired ahead and eight aft is superposed to fire over the aftermost. The be covered by all ten guns. Over a large angle, however, the fire of the port turret is masked on the starboard side by the starboard turret, and *vice versa*, and the lengthy experiments which were carried out in the Mediterranean early this year are believed to have proved that the compromise is not a very happy one.

At any rate, it has been abandoned in later ships The "Orion," "Thunderer," "Conqueror," and "Monarch" (1909-10 programme), and the "King George V.," "Centurion," "Ajax," and "Audacious" (1910-11 programme), will have ten 13.5-inch guns in five turrets, all on the center line. The second from forward will be superposed, so that four guns will bear forward; and the same arrangement is repeated aft, the fifth turret being amidships (Fig. 7). In these ships, therefore, Great Britain for the first time acknowledges the superiority of the all-on-the-center-line system which has been applied to American "Dreadnoughts" since the first was designed. The ten 14-inch guns of the "Texas" and "New York" will be mounted on this plan.

The last of the known five-turreted ships are the Italian vessels "Conte di Cavour," "Leonardo da Vinci," and "Giulio Cesare." In the case of the last two it is possible that the original design may not be adhered to, but they were all designed to carry, and the "Conte di Cavour" at any rate will be equipped with, thirteen 12-inch guns arranged as shown in Fig. 11 of the diagram. There will be three three-gun turrets, one forward, one aft and one amidships, and two twin-turrets will fire over the fore and aft turrets respectively. There will thus be a full broadside fire of thirteen 12-inch guns, while five will bear ahead and astern. If this arrangement is not carried out in the other two ships it will be to allow of the mounting of heavier guns. It may be mentioned that the guns in the triple-turrets are arranged on two levels, two being below, and the third above and between them In this way the breadth of the turret is saved at the cost of additional height.

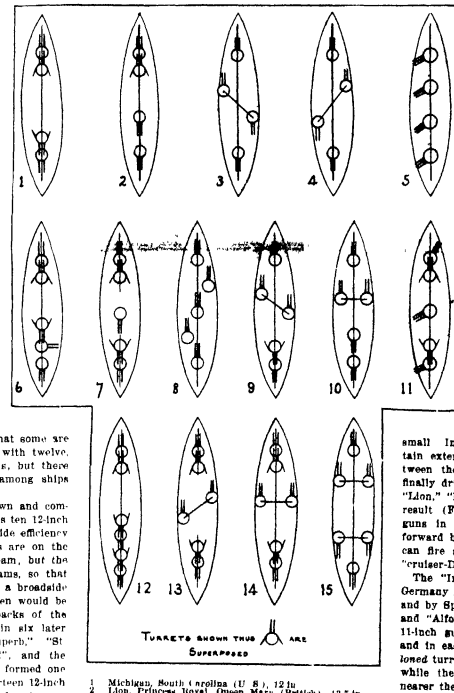
There are comparatively few four-turreted "Dreadnoughts." The first were, of course, the American "Michigan" and "South Carolina," although for various reasons they were not at sea until after the British "Invincible" cruisers The "Michigans" have eight 12-inch guns in four turrets, two forward and two aft, the one nearer the middle of the ship being superposed in each case (Fig 1). The British "Invincible," "Inflexible," and "Indomitable" also have a nominally full broadside (Fig. 3), two turrets being on the center line, and two *en échelon* amidships; but the latter (as in the "Neptune") are so close together that the arc covered by eight guns is very small In the "Indefatigable" this fault was to a certain extent remedied, by increasing the distance between these two turrets; but the authorities were finally driven to adopt the American system, and the "Lion," "Princess Royal," and "Queen Mary" are the result (Fig. 2). These ships have eight 13.5-inch guns in four middle-line turrets, the second from forward being superposed Only two guns, therefore, can fire aft, as compared with six in the previous "cruiser-Dreadnoughts" built for the British navy.

The "Indefatigable" system has been followed by Germany in the case of the "Von der Tann" (cruiser), and by Spain in the battleships "Espana," "Jaime I.," and "Alfonso XIII." The "Von der Tann" has eight 11-inch guns and the Spanish vessels eight 12-inch; and in each the longitudinal space between the *échelonned* turrets is much more than in the British ships, while the starboard turret, instead of the port, is nearer the bows (Fig 4). The British cruisers "New Zealand" and "Australia," building for Pacific service, are similar to the "Indefatigable."

The other known four-turreted ships are equipped on the triple-turret system, which has lately come into considerable vogue All are armed with twelve 12-inch guns, their names and nationality being: "Petropavlovsk," "Poltava," "Sevastopol," and "Gangut" (Russian), "Dante Alighieri" (Italian), and "Viribus Unitis," and a vessel at present known as "V" (Austrian). It has been rumored that in the case of the Austrian ships two turrets will be superposed, but this lacks confirmation (Fig. 5).

"Dreadnoughts" with six turrets are again comparatively few in number, but present some striking contrasts. The American "Wyoming" and "Arkansas" have twelve 12-inch guns in six center-line turrets, two forward and four abaft of the superstructure.

(Continued on page 326.)



1 Michigan, South Carolina (U. S.), 12-in
2 Lion, Princess Royal, Queen Mary (British), 13.5-in
3 Indefatigable, Invincible, Indomitable, Indefatigable, New Zealand, Australia (British), 12-in.
4 Espana, Jaime I., Alfonso XIII (Spanish), 12-in Von der Tann (German), 11-in
5 Gangut, Poltava, Petropavlovsk, Sevastopol (Russian); Viribus Unitis, "V" (Austrian); Dante Alighieri (Italian), all 12-in. Plan 3, with triple turrets, has been suggested for Russian ships
6 Delaware, North Dakota, Florida, Utah (U. S.), 12-in
7 Texas, New York (U. S.), 14-in; Orion, Thunderer, Conqueror, Monarch, King George V., Centurion, Ajax, Audacious (British), 13.5-in
8 Plan suggested by Mr James McKechnie (of Messrs Vickers) for 16,000-ton ship fitted with internal combustion engines.
9 Neptune, Hercules, Colossus (British), 12-in
10 Dreadnought, Bellerophon, Temeraire, Superb, St Vincent, Collingwood, Vanguard (British), 12-in
11 Conte di Cavour, Leonardo da Vinci, Giulio Cesare (Italian), 12-in.
12 Wyoming, Arkansas (U. S.), 12-in
13 Moreno, Rivadavia (Argentine), Minas Geraes, Sao Paolo (Brazilian), 12-in
14 Courbet, Jean Bart, France, Paris (French), 12-in.
15 Kawachi, Settsu (Japanese), 12-in.; Nassau, Westfalen, Rheinland, Posen (German), 11-in.; Oesterreich, Holland, Thuringen, Oldenburg (German), 12.2-in.

THE DISPOSITION OF GUNS IN DREADNOUGHTS

Abstracts from Current Periodicals

Phases of Science as Other Editors See Them

Atmospheric Pressure in Past Geological Ages

THE modern development of aviation suggests the question whether the atmosphere of the earth was denser during the carboniferous epoch than at the present day.

This subject is briefly discussed by a writer in *Cosmos*, whose remarks we reproduce here.

"Among the animals which people the earth we find representatives of all sizes, from the microscopically small animalcule to the great elephant. But within the limits of any one species the scale upon which the individuals are built does not differ very materially; we do not, for example, find specimens say ten times larger than their adult congeners

"It is easy to show good mechanical and physical reason why this should be so. Consider two birds, geometrically similar, such as two swallows for example, and imagine the second to have ten times the normal size. This bird will then have all its linear dimensions ten times as great as the normal bird, while the surfaces will be one hundred times as great In this way all the cross sections, the thickness of the muscles, especially of the wing muscles, being increased one hundred fold, we may safely take it that the strength of the bird will also be increased in the same proportion. But on the other hand, it must be remembered that the volume, and hence the weight of the body, will be increased one thousand fold. Thus this large swallow, built on ten times the normal scale, would find itself quite unable to rise into the air or to sustain itself there, for it is relatively ten times less strong than its congeners: with muscles one hundred times as strong as theirs it is called upon to perform one thousand times the work.

"As a matter of fact, an examination of the flight of different kinds of birds having approximately the same form shows that flight becomes more and more difficult as the weight increases; large birds substitute as far as possible sailing flight (which is the characteristic motion of our aeroplanes) for flapping of the wings Thus the size of animals capable of flight has an upper limit, and this seems to be reached, in the present state of nature, by the large birds, so far as sailing flight is concerned, and by the large insects, so far as flight by wing vibration is concerned

"And yet in past ages much greater animals have flown. One reptile of the group Pterodactyl had a span of over thirty feet, which exceeds that of a racing Blériot; this creature lived during the cretaceous period and flew as far as 90 miles inland Certain dragon flies of the carboniferous era measured over three feet from tip to tip of their outspread wings. Under present conditions it would be quite impossible for these creatures to fly. The most natural supposition is that in the times when these creatures flew through the air, the atmosphere had a greater density than it has at present. This is the conclusion reached by Mr. Harle In the estimation of this paleontologist, the existence of these great flying animals during cretaceous and carboniferous times indicates that atmospheric pressure at that time was greater than at present."

The Autogenous Cutting Process in Handling Wreckage

FOR some time past, the well-known autogenous fusing process (oxy-acetylene blowpipe) has been used with great success for clearing up wreckage after fires, explosions, and similar accidents An interesting case occurred in a town in Germany, where a school building in the course of construction collapsed, burying a number of workmen under the debris. As good fortune would have it, an oxy-hydrogen cutter happened to be available in the immediate neighborhood, and with its aid the iron parts were cut through in short order, and the workmen were extricated from their hazardous position.

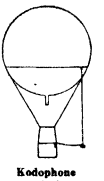
The importance of the oxygen blast is, of course, still greater in cases in which the construction is entirely made of iron. Thus, for instance, it was very extensively used in clearing up the wreckage after the collapsing of a large gasometer in Hamburg in December, 1909.

The lightning rapidity of the cutting burner is of particularly great utility in the case of railway disasters, where it is essential that the work be performed as quickly as possible so as to clear the road. At the present day, numerous railway corporations have adopted autogenous cutters as a part of the equipment of their wrecking cars. Municipal fire departments also have installed this apparatus.

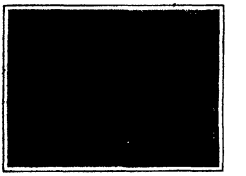
In Germany the process is almost universally carried out with hydrogen and oxygen instead of acetylene and oxygen, because the hydrogen is readily compressible into steel bottles, while acetylene cannot be thus stored without special precautions, since it is liable to explode.

The Kodophone

IT is very desirable for an aeronaut to know the vertical velocity of his balloon, relatively to the air Instruments for indicating this relative velocity have been invented by Neumann and by Lentz The name Kodophone has been given by Lentz to his instrument, which is described as follows in *Prometheus*: A small windmill is suspended from the balloon, with its plane of rotation horizontal, in the manner indicated in the diagram. The windmill is connected by wires with two electric bells of different pitches and a battery, contained in a case which is attached either to the side of the car or to the suspension ring above the aeronaut's head The connections are made in such a manner that one bell sounds when the balloon rises, and the other when it sinks, relatively to the air The velocity of relative ascent or descent is indicated by the length of the interval between successive strokes of the bell This automatic device is especially valuable at night and at any time when the aeronaut's attention is distracted for any reason.



Kodophone attached to balloon.



The Kodophone.

A Practical Manufacturer on the Synthesis of Rubber

IN the May number of the new journal *Kunststoffe*, Dr. Gerlach-Hannover, a practical rubber manufacturer, makes the following statement

"The problem of producing caoutchouc synthetically has been solved. But just as in the case of indigo 20 years elapsed before the synthetic product was successfully launched, it will take at least 20 years before synthetic rubber will make its appearance commercially. It will take perhaps longer with caoutchouc because the physical properties of this material are not as well known as those of indigo The high price of the natural product stimulated research and, after the pioneering experiments of Harries, the Elberfeld Farbenfabriken have finally succeeded in producing larger quantities of a product derived from a material closely related to isopren At this stage of the development it was found out that there exist many sorts of rubber which are near relatives but still possess different characteristics

"The first synthetic caoutchouc which was placed at my disposal, for example, did not unite with sulphur and had a leathery appearance This was not to be wondered at, as there are known some varieties of natural caoutchouc which cannot be vulcanized Soon another sort of rubber came to my notice which showed better affinity for sulphur, but still could not be perfectly vulcanized Above all it lacked elasticity Soon, however, larger quantities of a third sort were submitted to me which to my great astonishment showed all the excellent properties of natural rubber.

"But now the question arises whether this material of the Elberfelder can be economically produced on a large scale and may thus become a danger for natural rubber. It cannot be denied that the substance, which possesses good qualities, can be utilized for practical purposes. Its price is not high but it is a complex question to decide whether this synthetical product will become a danger to natural rubber All kinds of economical and commercial conditions must be taken into consideration One thing, however, is certain, that synthetic rubber will soon be a commercial article"

Highway Engineering as a Profession

ACCORDING to Prof Arthur H Blanchard, who recently lectured before the Society for the Promotion of Engineering Education, the technical graduate who is attracted to highway engineering has several more or less well-defined fields open to him These are

"The highway departments of municipalities and towns, those of States, counties and parks, the engineering organizations of contractors, and the engineering and sales departments of companies dealing in materials and machinery used in highway work In city and town work matters relative to the construction and maintenance of streets and pavements compose the bulk of the work assigned to the highway departments, together with more or less road engineering problems With State, county and park departments, the construction and maintenance of all types of road surfaces and bituminous pavements constitutes 90 per cent of the work of such organizations, while certain problems in street pavements and highway bridges have to be dealt with occasionally The prevailing idea, however, that the two fields just mentioned are easily separable, and that the preparation for one should not be the preparation for the other, is essentially wrong Since the lines of demarkation between the above fields are rapidly becoming obliterated, the successful highway engineer of to-day, whether engaged by the city or State, must have a comprehensive knowledge of all branches of highway engineering and allied subjects Otherwise it is obvious that it will be impossible to follow that important principle of economics of highway engineering, the adaptation of methods and materials to local conditions

"In contemplation of these opportunities, the essential prequisites of a successful career as a highway engineer must be given due consideration in order that the future prospects offered by this field of engineering may be thoroughly understood"

Prof Blanchard recommends four years' training in a course in civil engineering, practical experience in both field and office in connection with the construction and maintenance of roads and pavements on a system of highways, and the acquisition of knowledge along certain lines of particular value to the highway engineer, by which last is meant knowledge of the economics of highway engineering materials of highway engineering, management engineering, highway laws and systems of administration, mechanical appliances used in highway engineering, highway bridges and culverts, road and street surveying, drafting and designing, methods used in road material laboratories, advanced dynamic and structural geology, lithology, petrology and petrography, processes of industrial chemistry, methods of testing bituminous materials and the interpretation of results, and finally advanced highway engineering covering the most recent practice throughout the world in the construction and maintenance of all kinds of roads and pavements

The problem before the educational institutions of this country is that of determining by what method the subjects outlined above can be offered upon a practical basis Prof Blanchard does not favor a four years' undergraduate course in highway engineering, partly because undergraduate students are not sufficiently mature to acquire the benefits which should be derived from a combination of practical experience and specialized knowledge

The most practicable plan is to arrange a definite course of instruction as a unified graduate course based on the assumption that the technical graduates enrolled for the master's degree will hold undergraduate degrees in civil engineering If the graduate instruction is to be given in the period from about December 1st to about April 1st, it will be possible for practising highway engineers, especially first, second, and third year graduates, to use the winter period advantageously in acquiring advanced knowledge under favorable circumstances

Columbia University will offer a course next year which will cover the field of subjects referred to in Prof. Blanchard's paper, and will in amount, be sufficient to satisfy the requirements for the master's degree

The Heavens in October

Some Difficulties in Plotting Comets' Orbits

By Henry Norris Russell, Ph.D.

ALMOST the only real difficulty in preparing such articles as these arises when a new comet is discovered. To give a detailed account of its motions during the ensuing month, the writer must have before him an ephemeris of the comet's place for the next five or six weeks, and this is not always forthcoming. An approximate orbit is indeed usually calculated by the time a comet has been in sight for a week, and its motion predicted by the end of this for two or three weeks more. But these preliminary orbits are often not very accurate. The difficulty may be illustrated by that of finding the exact size and position of a circle which passes through three points, *A*, *B*, and *C* close together and nearly but not quite in line.

If we suppose that the position of the point *B* has been observed and that a slight error has been made placing it at *B'* instead of its real position, our calculations will lead us to the circle *A B' C D'* instead of the correct circle, *A B C D*. Within the region covered by the original observations, the two circles will be quite close together, but outside this region they will deviate from one another at an ever-increasing rate.

The mathematical processes involved in calculating a comet's orbit are closely analogous to this simple case, though much more complicated. It is, therefore, easy to see that a small error in one of the observed positions of the comet, on which the calculations are based, may give rise to an enormously greater error when the attempt is made to predict, by means of these calculations, where the comet will be after an interval of time ten times as great or more, than that covered by the original observations.

It is therefore not worth while to use the preliminary orbit of a comet to predict its motion for more than two or three weeks. Before the end of this time, many more observations can be secured, and an improved determination of the orbit made (just as, in our diagram, it is evident that, if we had observed the positions of two or three more points on the circle between *C* and *D* even with errors as large as that made in the case of point *B*, the whole set of such observations would suffice to fix the position of the true circle with considerable accuracy).

For these reasons it is the exception, rather than the rule, when an ephemeris predicting a comet's position till the end of a given month is available by the 15th or 20th of the preceding month, and this explains why the predictions concerning newly discovered comets, appearing in these columns, may sometimes appear vague.

Brooks's comet, mentioned last month, is a case in point. In this instance too, the early estimates of brightness seem to have been too low. The comet has not only become visible to the naked eye but fairly conspicuous.

Its orbit is now pretty well determined, perihelion passage occurring near the end of October, at a distance of some 40 million miles from the sun.

During the early days of the month it will be visible in the evening sky, though the moon, then in her second quarter, will interfere with observation. There ought, however, to be no difficulty in identifying the large diffuse head of the comet with a field-glass.

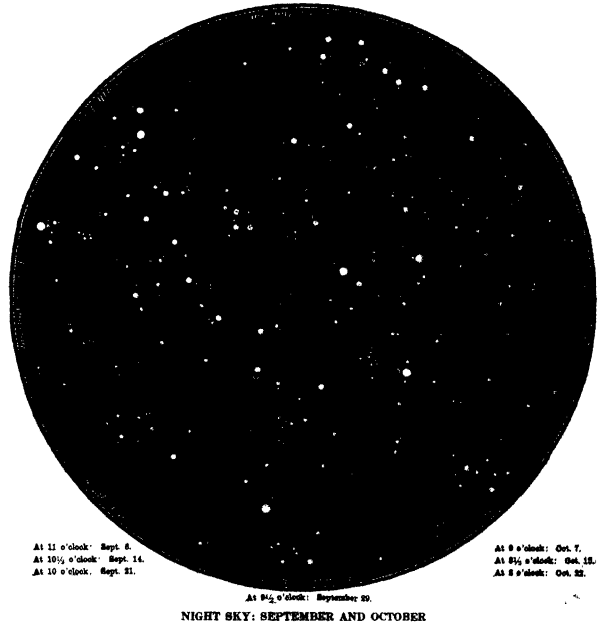
Later in the month it passes between the pole and the sun, and for a few days will be visible both in the evening and the morning, low in the northwest after dark, and low in the northeast before dawn. At the time of perihelion, toward the end of the month, it will be in Virgo, rising more than two hours before the sun, and should be a fairly conspicuous object after new moon, when the morning skies are dark.



Slight shift of B makes very different curve

THE HEAVENS.

At the hour for which our map portrays the appearance of the sky the Milky Way forms a vast arch passing almost through the zenith. Along this are many fine constellations—Sagittarius, low in the southwest; Aquila, well up in the same quarter, Cygnus, almost overhead, but a little west of the zenith; Lyra, west of this; Cassiopeia, high in the northeast, the less conspicuous Cepheus, just above the Pole star; Perseus, at a moderate altitude in the northeast; and finally Auriga, just rising below him.



At 11 o'clock: Sept. 6.
At 10½ o'clock: Sept. 14.
At 10 o'clock: Sept. 21.
At 9½ o'clock: September 30.
At 9 o'clock: Oct. 7.
At 8½ o'clock: Oct. 15.
At 8 o'clock: Oct. 22.

NIGHT SKY: SEPTEMBER AND OCTOBER

The Great Bear is low on the northwestern horizon, and the Dragon, coiling around the Little Bear, is higher up. Boötes has almost set in the northwest, and Corona is very low. Hercules is a little higher, on the way toward Lyra. Ophiuchus and Serpens are also represented by only a few stars in the west.

Capricornus and Aquarius fill a large, dull region in the southern sky. Below them is an isolated star, which from its very loneliness seems all the brighter. This is Fomalhaut, the only conspicuous object in the constellation of the Southern Fish. A nearby horizontal line of five stars of the fourth magnitude, not shown on our map, but visible easily enough on a clear night, form the remainder of the constellation.

Fomalhaut is of some interest as being within a measurable distance, though not one of the very nearest stars. Its parallax is 0.14 second, corresponding to a distance of 26 light years, and its actual brightness is about fifteen times that of the sun.

Below Fomalhaut, and now on the meridian, is the far southern group of Grus, the Crane. Its two brightest stars, of the second magnitude, barely rise above the horizon of New York, but it is a conspicuous constellation in lower latitudes. The great square of Pegasus is close to the zenith, on the southeast. Andromeda is just to the left with Triangulum and Aries below her. Taurus is rising, a little north of east. Cetus and Pisces fill the southeastern sky.

THE PLANETS.

Mercury is morning star until the 23rd when he passes behind the sun, and becomes evening star. He rises about an hour and a quarter earlier than the sun at the beginning of the month, and should be fairly easy to see. By the 15th he is lost in the sun's rays, and remains so until November is half over.

Venus is likewise a morning star, but is much farther from the sun, and exceedingly conspicuous—reaching her greatest brilliancy on the 21st. She rises about 4:15 A. M. on the 1st, and just before 3 A. M. on the 31st. At 1 P. M. on the 18th she is in conjunction with the moon. Though 7½ degrees south of the latter, she can then be easily found with the naked eye—her great brightness making her clearly visible, even at noon.

Mars is in Taurus, not far from Aldebaran, rising about 8:30 P. M. on the 1st, and 6:30 on the 31st. He is steadily approaching the earth, and by the end of the month is less than fifty million miles distant, which makes him appear very bright.

Jupiter is evening star at the beginning of the month, setting about 7 P. M., and too near the sun to be easily seen. As he passes through conjunction on the 23rd, he is practically invisible later in the month. Saturn is in Aries, approaching opposition. He rises before 7 P. M. in the middle of the month, and is well seen before midnight.

Uranus is in quadrature with the sun on the 19th, and can be observed in the west in the early evening. Neptune is in a similar configuration, on the other side of the sun, on the 17th, and is visible in the morning sky.

The moon is full at 11 P. M. on October 7th, in her last quarter at 7 P. M. on the 14th, new at 11 P. M. on the 21st, and in her first quarter at 2 A. M. on the 30th. She is nearest us on the 11th, and farthest away on the 27th. The present new moon is marked by an annular eclipse of the sun, visible along a tract passing from the Aral Sea through Turkestan, Tibet, and southern China, thence through the southern part of the Philippines, and over New Guinea. As a partial eclipse it will be visible over all southern Asia and Australasia from India to Siberia, and from Japan to southern Australia.

Besides the conjunction with Venus on the 18th, already mentioned, the moon passes near Saturn on the 10th, Mars on the 11th, Neptune on the 14th, Mercury on the 21st, Jupiter on the 23rd, and Uranus on the 29th, none of the observable conjunctions being close.

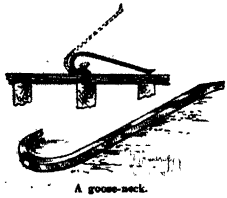
Princeton University Observatory.

The Inventor's Department

Simple Patent Law; Patent Office News; Inventions New and Interesting

A Goose-neck

ONE of the handiest tools in working around a house or small shop is a goose-neck, such as shown in the accompanying sketch. It is practically a small crowbar, pointed at one end to form a pinch bar and returned at the other end to form a claw which can be used for



A goose-neck.

pulling nails or small spikes. It is easily made, inexpensive, can be used in many ways and will be found especially useful in moving stones or other heavy objects, prying timbers apart, opening boxes, wrecking small buildings and in a hundred other ways in which a small, easily handled crowbar can be used to advantage.

A New Range Finder

THE accompanying illustrations convey a very fair idea of the appearance of the Barr and Stroud range finder, at present used in the British army and now undergoing a series of tests by officers of the United States army, stationed at Fort Sam Houston, Texas, with the view of determining what advantages, if any, it possesses over the Weldon instrument as used by our own government.

The principal claims of superiority of the Barr-Stroud finder over other instruments of similar nature are its portability, absence of all delicate mechanism, ease of manipulation and the fact that it obviates all necessity of the services of more than one man to establish a measured base.

The invention of the range finder was the outcome of a public advertisement, issued by the British War Office in 1888, for an instrument which would fulfill certain specified conditions.

In the working out of the design for the finder it was sought to make the accuracy of the instrument, so far as possible, independent of the precision of such mechanical parts as micrometer screws or any delicate mechanism which might become worn or deranged through hard continued service. This has been accomplished by the employment of a graduated deflecting prism to which the scale is directly attached.

As originally produced, however, the range finder fell far short of fulfilling expectations, due principally to the difficulty of making the optical parts, which are of exceedingly novel design. It was only within the past few years, when the quality of optical glass procurable had reached such a state of perfection, that the instrument was accepted.

In construction, the range finder consists of two telescopes of twelve powers each incorporated in a common tube, aggregating over two inches in diameter, leather covered and closed at both ends.

The light through each telescope is admitted through a square-shaped aperture near each end of the barrel, the lenses contained therein being protected from dust and other injury by a steel sleeve covering over the aperture. The light admitted through these apertures is directed [illegible] of reflectors along the inside of the tube to the eyepieces.

The whole arrangement is such that the combined telescopes may be simultaneously directed on the same target, the range finder forming the base of the triangle, having at its vertex the object, the range of which is determined by measuring the parallax.

The operation is exceedingly simple. To make an observation the observer grasps the handles and directs the instrument toward the object whose distance is to be ascertained, holding the range finder horizontal with the line of object.

In the right eye-piece are placed two mirrors separated by an extremely narrow horizontal line. Supposing the object selected is a flag staff, the picture presented to the observer will be that of a broken column the upper part of which has been moved to the left

In the case of looking at a tall building, the picture shown resembles nothing more than one brick overlapping another.

This distortion is due to the lack of coincident focus between the two telescopes; that portion of the image shown in the upper half of the field having been formed by the left hand telescope, while the lower portion of the image is formed by the right hand telescope.

The next procedure is to bring these broken lines into plumb, which is accomplished by means of a large screw having a milled head placed near the tripod head and so situated that it may easily be manipulated by the thumb and forefinger of the right hand while grasping the handle. This screw, when turned to the right, causes the upper half of the image to move to the left and its parts to separate; when the screw is turned to the left the two halves of the image are brought together, so that the perpendicular lines coincide at the dividing horizontal line and all distortion disappears.

When this is done the correct distance may be read through the left eye-piece, where a series of figures in yards appear on the surface of a wide disk, the scale having moved according to the direction in which the operating screw head was turned.

It will be seen therefore that the correct range always depends upon bringing the two halves of the image into exact alignment at the line separating the two mirrors

The advantages claimed for the finder are:

First. Only one observer required

Second The range of moving objects can be continuously observed

Third. It is not essential in the types suitable for infantry and cavalry that the instrument be level when taking observations.

Fourth. It can be used at night to take the range of distant lights.

Fifth. Rapidity of operation—30 seconds or less being all the time required for determining a range.

Sixth. It can be used from cover and from a prone position so that the observer's whereabouts are not disclosed to the enemy.

These range finders are made in sizes varying from those having 15 and 12 foot bases, for use on ship board and in sea coast forts, to an instrument with a 4 foot 6 inch base, for field artillery, down to those intended for infantry and cavalry, having bases of only 32 and 26 inches

It is the last and most portable model which may be carried in a case and slung over the shoulders that officers are now experimenting with at Fort Sam Houston

Its length over all is only 30 inches and its weight 7¼ pounds

The instrument may be used mounted on a light tripod or it may be used while standing erect with the aid of a light steel rod, the base of which rests in a socket carried in a belt and supported by shoulder braces, or by lying in a prone position upon the ground

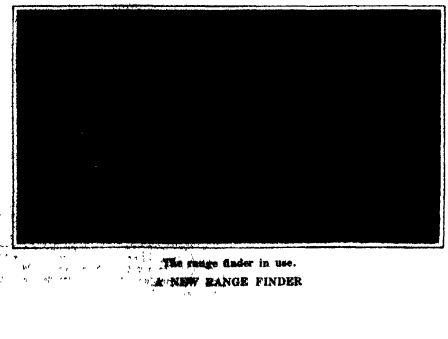
The claims as to ease of manipulation coupled with accuracy appear to be well founded. Upon one day of the tests a civilian spectator was asked to find the range of a building, distant nearly three miles. Within about 15 seconds he announced a result, which was only 140 feet out of the way, according to the calculations made by Col Brown himself Another spectator, measuring the distance across the parade grounds to the barracks, gave the correct reading (392 yards) at the first attempt.



Mounted on a tripod.



Supported from a belt at the waist.

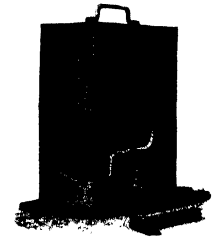


The range finder in use.

A NEW RANGE FINDER

A Gasoline Tank and Pump for Automobilists

MANY automobile users install gasoline tanks with pumps, in their yards, adjacent to their private garages. In some places the local fire regulations require that the tanks, when installed be located a given number of feet from any building The writer's attention was called to a cover and guard for the pumping devices of such a tank which protects the pump and prevents any unauthorized person from tampering with it It consists of a box open at the bottom and of such size and shape



A gasoline tank and pump for automobilists

as to fit over the pump Near the bottom of the box are two opposite slots, *A*, reinforced by metal plates *B* and a bolt *C*, with a head at one end an opening near its other end is passed through the slots *A* and secured by a padlock. This bolt *C* passes when the box is fitted over the pump below a bar *E* which extends between the filling pipe *F* and the dispensing or pump pipe *G* of pumps of the Bowser type, and so locks the guard box over the pump The box, such as shown, has been in actual use for several months and has proven satisfactory in every respect

Notes for Inventors

Cloth Pinions—Cloth pinions are highly successful devices for reducing the noise and increasing the life of power transmission gearing. Metallic gearing, especially steel, is always more or less noisy in operation, the noise becoming particularly troublesome in the case of high speed gear trains Furthermore iron or brass gearing has not sufficient elasticity to successfully withstand the shocks or back lash caused by the torque variations incident to the operation of machine tools such as punches, shears, planers, etc In order to overcome these drawbacks, various kinds of non-metallic substances such as rawhide and paper, have been used instead of brass and cast iron for one or more members of gear trains, but the results have been only partially successful As a rule pinions made of such substances were not sufficiently impervious to moisture or unaffected by exposure to heat, and in the case of rawhide were liable to injury by rats and mice when kept in stock In the cloth pinions developed by a prominent electric company, these defects are entirely eliminated, both by the nature of the material and the method of construction employed The blanks from which the pinions are cut consist of a filler of cotton or similar material confined, at a pressure of several tons to the square inch, between steel "shrouds" or side plates the whole structure being held together by means of rivets, or, in case of very small pinions, by threaded sleeves After the teeth are cut, the cloth filler is impregnated with oil. Cloth pinions are entirely impervious to moisture, unaffected by changes in atmospheric conditions and absolutely vermin proof. Cloth pinions have a wide range of application They are particularly suitable for use on the shafts of back

geared motors employed for driving lathes, planers, drill presses, shears, punches, and other machine tools, for loom and spinning frame drive in cotton, silk, worsted, carpet, and textile mills in general, for operating pulp and paper mill machinery, for driving printing presses, and for the valve, ignition and timing gear trains of automobile and other types of internal combustion engine.

The Deplorable Fertility of the American Inventor.—At a recent meeting of the National Electric Supply Jobbers, an address was made by one of the members, deploring the fertility of the American inventor, which, it is claimed, makes material antiquated before it can be disposed of by sale It is necessary to purchase material in quantities in order to get much of a profit, but before this can be disposed of there are new devices and features on the market which are preferred to earlier patterns Why not devise a new selling system instead of damning the inventor? Perhaps some thoughtful inventor will help this human back-number out

Another Lamp Filament Patent.—Carl Auer von Welsbach has just secured a patent on the manufacture of electric lamp filaments The process provides for eliminating the gases occluded in filament containing a metallic oxid and osmium by slowly bringing the filament up to a temperature sufficient to drive off the gases, but below the reduction temperature of the oxid, and finally increasing the temperature to white incandescence, and partially reducing the oxid

Recent Reissues.—On August 15th, 1911, four reissue patents were granted. In all four cases the reissues issued to assignees and the assignee in each case is a corporation

Battle Creek Patent Foods.—Three patents, No 1,001,044, 1,001,045, 1,001,149, for food compounds, and one patent, No. 1,001,050, for a food product, have been issued to Dr. John H. Kellogg of Battle Creek, Mich. The compound of the first patent includes gluten, legumes and yeast products, while the second substitutes nuts for the legumes, the compound in each case being cooked into a homogeneous mixture of fibrous consistency and meat-like flavor The compound in patent No 1,001,149 includes gluten, potato and yeast products, while the patent 1,001,050 combines casein, gluten, oil and a yeast product, the mixture in each case having a meat-like flavor

Another Ozone Patent.—The distribution of ozone is the object of an apparatus patented, No 1,001,038, to Frederic Georg Jaisch of Rheydt, Germany, assignor to Otto von Mühlmann of Brussels The apparatus comprises an ozonizer with a discharge conduit opening in front of the blades of a fan, with a funnel-shaped screen between the blades and the discharge conduit, a second screen being fitted to and spaced from the first screen and the conduit opening into the space between the screens

Blowing Bad Breath Away From the Dentist A dental appliance, providing means whereby a flat blast of air will be delivered between the face of the patient and that of the operator, thereby preventing each from inhaling the other's breath, has been patented, No 1,001,362, to Charles W. Davidson of Jefferson City, Mo

A Woman Inventor.—Women frequently invent devices for domestic use This is true in the case of Mary M Clarke of Des Moines, Iowa, who has secured a patent, No. 1,000,073, for a fish-scaling tool which has a handled scraper with a reticulated or wire screen guard extending in both directions beyond the scraper, the latter being shown as formed with a number of serrated scraping blades.

Col. Krag in America.—Col. Krag of Norway, inventor of the celebrated Krag rifle, is making an extended visit to this country and called at the Patent Office in Washington and was shown the interesting features of that branch of the government. The great inventor is a man apparently in the sixties, well preserved, and is greatly delighted with the courtesy and the hospitalities which have been extended to him.

The Government Advertises a Patent.—It is not often that a government publication exploits and advertises the sale of a patent, but a recent government publication, after describing an invention somewhat in detail, concludes with the following paragraph "The inventor is on the point of selling his French rights in the invention, and application has been made for a United States patent The experiments were witnessed by the editors of the three Havre daily newspapers, several members of the municipal council, and other authorities who signed a certificate of proof. A sample of the new will be loaned to interested firms which apply to the (giving here the name of the government office)."

Synchronously Operated Musical Instruments.—Samuel S Waters of Washington, D. C., has patented, No. 1,002,100, means for synchronously operating two musical instruments, in which a movable record for one instrument moves a member at a proportional speed and the record for the other instrument is caused by said member to move at all times at a speed proportional to the speed of the record of the first machine The patent is assigned to the Aeolian Company of New York city.

A Stand for Assembling Automobiles.—A stand for assembling vehicles, such as automobiles, has been patented, No 1,001,-619, to Howard E Coffin of Detroit, Mich., and includes means for supporting the axles and the main elements of the frame separately and in their normal relative positions and means for lowering the support to disengage it from the assembled vehicle to rest the latter on its wheels so the vehicle, when assembled, can move off on its own wheels.

General Electric Company Patents.—Among the patents issued August 29th, 1911, are eleven issued to the General Electric Company, the inventors including Elihu Thomson, Conrad Baumgardner, Fred B Corey, Allen A Tirrill, Howard E. Sargent and Kennett F Kingwell.

A New Pavement.—We do not always realize that the pavements we walk or ride on may be patented A patent, No. 1,001,-695, to August E. Schutte of Newton, Mass., is for a pavement consisting of a layer composed of stone, coated and cemented together with relatively pure Portland cement, with the spaces between the coated stones filled with bituminous cement.

A Gas-driven Locomotive.—In a locomotive patented, No. 1,001,703, by Arnold Stucki of Allegheny, Penna., is provided a suitable unit frame, carried by the locomotive wheels, and this frame is provided with a continuous gas-producing apparatus and with an internal combustion engine, connected with the producer, adapted to drive the locomotive wheels. An air pump is also carried by the unit frame and is adapted to start the engine.

A Queer Coffee Pot.—In patent No. 1,002,819, to Franklin V. Brooks of New York city, is shown a coffee-making device in which a coffee pot and a boiler, side by side, are pivoted so they can swing to bring one or the other over a heating lamp. The boiler is held over the lamp until the water is transferred from the boiler to the coffee pot, when the weight of the water will operate automatically to swing the coffee pot to a position over the lamp.

A New Kind of Box Kite.—Patent No. 1,003,062 has been issued to Albert O. Paulson of Los Angeles, Cal., for an air ship characterized by a pair of box kites fore and aft and connected together and mounted with an edge at the top and bottom and having the lower corners cut away to admit air. Horizontal sustaining surfaces are provided on each kite.

Making Flour by Steam.—A new process of making flour or meal is presented in the patent, No. 1,002,990, to Charles Herendeen of Chicago, in which steam is injected into a mass of cereal to disrupt the starch cells, after which the mass is dried by passing it through blasts of air, and is then ground into flour or meal of any fineness.

A Novel Amusement Device.—William C Sanford of Kent, Wash., has patented, No. 1,002,874, an amusement device in the form of a transparent barrel having a visible outlet, and an invisible outlet by which the receptacle may be emptied while the visible outlet is closed. The barrel is suspended by a number of lines and one of the lines is hollow and connects at one end with the invisible outlet, while its other end leads to a suction pump, placed out of sight, and which can be operated to pump the contents of the barrel.

An Automatic Pile Cleaner.—For protecting piles, Charles N. Hubbard of Anacortes, Wash., provides in a patent, No 1,002,847, a float, surrounding the pile so it will rise and fall with the tide, and a brush is connected with the float so it will move along and brush the pile as the float moves up and down. A quantity of a suitable preservative is carried by the float and conducted by pipes to the brush so it can be distributed to the surface of the pile

A New Twist Drill.—The Hoefer Manufacturing Company of Freeport, Ill., as assignee of Frederick W. Hoefer, has secured a patent, No 1,002,846, for a twist drill whose shank is twisted alternately in opposite directions, the shank being so twisted from a flat bar.

Legal Notes

Conflict Between Commissioner's Decision and Bill in Equity.—The Assistant Commissioner of Patents, Mr Tennant, has decided in the case of McIntyre v. Perry that where, after a decision on priority by the Court of Appeals of the District of Columbia, the defeated party files a bill in equity under the provisions of section 4915 Revised Statutes, the filing of such bill does not operate as a *supersedeas* of the judgment and that the issuance of the patent to the party who succeeded before the Court of Appeals cannot be suspended pending the final determination of the suit.

Invention Completed in a Foreign Country.—In affirming the decision of the Commissioner of Patents in the case of De Kando v. Armstrong, the Court of Appeals of the District of Columbia has decided that where a party completed the invention in issue in a foreign country and knowledge of such invention was brought into this country and disclosed to others, the foreign inventor can derive no benefit from the work done in such foreign country and the disclosure of the invention to others in this country is not equivalent to a reduction to practice of the invention, but is merely evidence of conception thereof. In concluding his decision, Mr. Justice Van Orsdel says:

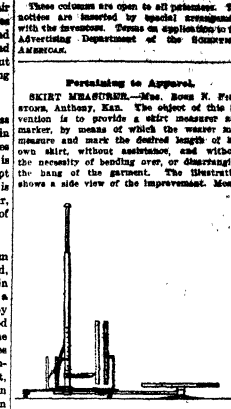
"The right of appellee to a patent cannot be superseded by any act of appellant's short of a reduction to practice prior to appellee's filing date Had his foreign invention been reduced to practice here prior to that date, appellee's conceded lack of diligence would have been sufficient to have entitled appellant to the award of priority, but, inasmuch as, in reduction to practice abroad cannot be considered, appellee must be regarded as the prior inventor."

RECENTLY PATENTED INVENTIONS.

These columns are open to all patentees. The notices are inserted by special arrangement with the inventors. Terms on application to the Advertising Department of the SCIENTIFIC AMERICAN.

Pertaining to Apparel.

SKIRT MEASURER.—Mrs. Rosa N. Fenstrom, Anthony, Kan. The object of this invention is to provide a skirt measurer and marker, by means of which the wearer may measure and mark the desired length of her own skirt, without assistance, and without the necessity of bending over, or disarranging the hang of the garment. The illustration shows a side view of the improvement. Means



SKIRT MEASURER.

provide for the skirt being brought against the marking material which results in the making of a transverse mark on the skirt. The skirt is brought back to first position and the wearer then revolves the platform the desired distance, and makes another mark on the skirt. This process continues until the measuring and marking is completed.

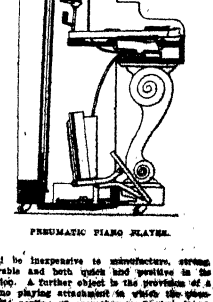
Of Interest to Farmers.

BUTTER AND MILK MIXER.—C T. Rayton, Buffalo, N. Y. In operation a quantity of butter and milk is first placed in the body of the apparatus, the proportions being preferably a pint of milk to a pound of butter, and the dasher is then operated for the purpose of cutting up the butter and working them together, so as to merge them and form practically one substance, or a butter compound which becomes solid the same as butter proper

Of General Interest.

FERTILIZING SCALE POISON.—W B Kleckner, Bay City, Mich. This poison destroys all kinds of parasitical insects infesting various parts of fruit, forest and ornamental trees or shrubs and vines, and, further, operates to discharge food products directly into the sap, supplying an immediate stimulation and fertilization of all tissues and growing parts of trees, quickly correcting the failing activity and low vitality caused by the ravages of parasitical insects or by depleted and unsatisfactory soils

PNEUMATIC PIANO PLAYER.—William G MacArthur, 428 E. 149th St., New York, N. Y. This invention relates to an improved piano-player, an accompanying illustration of which shows it in a vertical section through a piano with the attachment thereon. An object of the invention is to provide a device which



PNEUMATIC PIANO PLAYER.

will be inexpensive to manufacture, strong, durable and both quick and positive in its action. A further object is the provision of a piano playing attachment in which the pneumatic portion of operating mechanism is positioned directly to the keys, thereby a great saving in space and more positive and sensitive movement is obtained.

PICKLING OF PICKLING.—A. SAGMANN, New York, N. Y. This process is for use in making edible and easily digestible acid pickles from green cucumbers, in a simple and economical manner, and reducing the loss of pickles, that usually become tainted and soft, to a minimum. The process subjects green cucumbers to the action of dilute boiling acid solutions of common salt, chemically pure hydrochloric acid and soda bicarbonate.

PILE PROTECTOR.—C. N. HUBBARD, Anacortes, Wash. The particular object of this device over that shown in the former patent granted to Mr. Hubbard, is to provide a pile protector so constructed that the chemical compound used in protecting the pile may be carried to a greater depth than ever before, whereby the extermination of teredo and limnoria and other marine worms is facilitated.

STAMP HANDLING DEVICE.—R W. JONES, Lincoln, Neb. This improvement has reference more particularly to a device comprising a casing constituting a magazine for the stamps, a guide member associated with the magazine and adapted to have the stamps passed along it manually, from the casing to the point of application of the stamps, and a moistening device for wetting the adhesive of the stamps before they are applied.

TRAP.—T. H. TAYLOR, Luserne, N Y The intention here is to provide a trap for trapping animals. Use is made of a fixed toothed jaw constituting a base, a swinging jaw mounted on the toothed jaw, a tripping rod for engagement with the swinging jaw, and a tripping plate on the fixed jaw and adapted to be releasably engaged by the tripping rod.

COUPLING FOR REINFORCED CONCRETE PIPES.—C. H. WILSON, Red Oak, Iowa. An object of this inventor is to provide a means for uniting two pipe sections of various lengths in a manner that there will be a positive and tight joint between the different sections, and it has for a further object the disposition of this coupling means so that they are not exposed to the weather and are thereby protected from any rusting action.

FORM FOR PRODUCING ARTIFICIAL TOOTH CROWNS.—E. R STEVENSON, Oakland, Ore. In this case the improved tooth form being hollow is adapted to receive a plug or other device adapted for expanding it, and thus, by using different sized plugs or expanding devices, the form may be enlarged circumferentially so that several sizes of crowns may be produced by means of one form, and also the shape of the form may be changed to a certain extent, by using plugs differing more or less in contour.

BAKER'S OVEN ATTACHMENT.—R. L. GILLESPIE, New York, N. Y. In this instance the improvement pertains to an attachment for a baker's oven, in the form of an inlet, whereby access may be had to the interior of the oven in a most convenient and readily accessible manner by means which can be readily controlled, and which will be simple and inexpensive.

GUN LICENSE CERTIFICATE HOLDER.—O R. DUNCAN, Jefferson, Iowa. The purpose here is to provide a license certificate holding receptacle which is to be attached so that the hunter may be certain to have the license certificate with him every time he takes his gun to go hunting The receptacle is attached to the barrel by a clamp having arms which are curved and are disposed against the outer side of the barrel or barrels, the clamp arms being held against the gun barrels by a screw member.

ATTACHMENT FOR TRIAL FRAMES.—G. A. GRIFFIN, New York, N. Y. The aim here is to furnish an attachment for supporting a smaller lens substantially parallel to the trial lenses and adjacent the lower portion thereof, so that the eyes may be tested both for long distance and for reading at the same time, and the patient may know the advantages and operation of using a bifocal lens rather than having separate pairs of eyeglasses or spectacles for general use and for reading.

Hardware and Tools.

PICK.—J. E CARTER, Reno, Nevada. Among the principal objects which this present invention has in view are:—To provide a construction and arrangement of a pick to facilitate the replacement of steel points, and to provide a construction and arrangement which renders possible the carriage of a supply of renewing pick points adapted for attachment to the pick body or eye.

MITER BOX.—J. G. WORTHAM, Tullahoma, Tenn. This box consists of a bed, which may be widened or narrowed to conform with the dimensions of the work, a swinging arm supporting and carrying the saw guide, and capable of being lengthened and shortened, to correspond with the positions of the bed sections, and an adjustable bed, together with a scale for indicating angles assumed by the arm.

DUST PREVENTER FOR STONEWORKING TOOLS.—W. M. HOLDEN and E. M. TUBIN Barre, Vt. To avoid several objections this invention is devised, and consists of a fluid discharge pipe having an extended atomizing puller, and a liquid supply member arranged to discharge on the said outlet, the above pipe communicating from the exhaust of the tube, with the extended atomizing outlet of liquid flow.

PENCIL HOLDER.—A. B. COFFIN, Apache, Okla. Among the principal objects which the present invention has in view are: to provide a simple, economical and efficient form of pencil holder for pencils, fountain pens and articles of a similar character; and to provide a holder light in construction and adapted for easy attachment to the clothing of the user.

LOCK.—Y. Q. CALDWELL, Paris, Tenn. Although the form of this device is that of a padlock, it may be utilized in other forms of locks such as trunk locks, or similar devices. An object of this invention is to provide a device strong and durable, because it consists of relatively few parts Owing to its peculiar construction it is difficult to pick, and the parts may be easily assembled or disassembled

HASP LOCK.—Y. Q. CALDWELL, Paris, Tenn An object of this improvement is the provision of a combined lock and hasp, which does away with the necessity of the use of a padlock or other means for securing the hasp to the staple. It is in the simplicity of the lock and the elimination of a multiplicity of parts that the merit of this invention lies, as well as in the fact that these few parts are strong and durable and are not liable to get out of order.

Heating and Lighting.

JOINT AND COUPLING.—B W STOUFFER, Pittsburgh, Pa. This improvement provides a joint and coupling, more especially designed for use as a swing joint, socket joint, coupling or other gas fixture, and arranged to permit of conveniently placing the joint or coupling in position on any desired fixture without the aid of tools and without danger of leakage or the parts becoming accidentally disassembled or separated

Household Utilities.

DUMB-WAITER.—E N HALLETT, Canton, Pa. In this case the invention provides a pantry closet on a dumb-waiter so that when food is placed on the shelves of the closet the dumb-waiter may be lowered through an opening in the floor of the kitchen to the cool air of the cellar. A supporting frame is constructed on the waiter so that when it is lowered with the frame, the working parts are disposed below the floor of the kitchen

VENTILATOR.—W. F GUILMETICH, Merlden, Conn. This invention has for its principal objects to provide a ventilator adapted to be attached to a window and to cause the ingress of air into the interior of a building without causing a draft, at the same time keeping out all objectionable foreign matters and substances, and to provide such a ventilation with means for regulating the influx of air to the desired extent

Machines and Mechanical Devices.

WAVE MOTOR.—A. W DOWE, Camden, N J This invention provides means to avoid the destructive operation of the elements incidental to storms. provides a construction which receives and transmits the full dynamic power of the surf or waves at the shore line; and provides a machine the power or full efficiency of which may be augmented to a large degree by multiplying the motor units indefinitely

HINGE MECHANISM FOR THE COVERS OF LOOSE LEAF BOOKS.—F L. IMPEY, 19 Barwick Street, Birmingham, England This mechanism is for use on leaf books or binders of the type in which the covers are pivotally connected at their rear edges to clamping bars by which the leaves are bound in position, the covers being connected together by leather thongs, which pass through the clamping bars and are tightened or released for securing or liberating the leaves by mechanism arranged within one or both of the covers

WELL DIGGING APPARATUS.—C R MARTIN, Portland, Ore The invention refers to apparatus for digging wells, and for forming bores in the earth, and has reference more particularly to apparatus comprising a casing adapted to be advanced to the core as it is formed, a drill-head associated with the casing and means for conducting fluid pressure to the drill head to cause it to advance into the earth

GREASE CUP.—FRANK L. TERREE, care of R S HADLEY, 1806 11th Ave, Altoona, Pa. An object of this invention is to provide a cup for holding hard grease of a semi-fluid nature with means for forcing the grease through a feed opening. A further object is to provide a device which may be readily filled and in which



GREASE CUP.

the cover forms a guide member for the stem of a movable plunger or piston. Again, the aim is to provide a cup of maximum capacity, owing to the fact that part of the mechanism for exerting a pressure on the grease is disposed on the exterior of the cup rather than on the interior The illustration gives a perspective view of the device in operative position

ADVERTISING DEVICE.—H E KIESSIG, Sacramento, Cal The object here is to provide a device for continuously operating that class of advertising devices known as "Chinese puzzles," or "Jacob's ladders," and consisting of a plurality of plates or panels, so connected that when the topmost panel is severed, the other panels will be reversed in succession from above downward

VENDING MACHINE.—C S. HARDY, San Diego, Cal The purpose of the invention is the provision of a device which will dispense accurately measured quantities of liquid, without the necessity of an attendant, and which will be operated by the liquid, under pressure. A further object is to provide a device wherein the amount dispensed may be varied, by varying the capacity of the pump

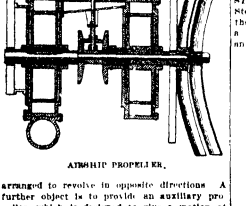
DEVICE FOR ELEVATING WATER, MERCURY, OR OTHER LIQUIDS.—JAMES R HALL, Winnfield, La This invention relates to means for raising water, mercury or other liquids to a higher level It is an improvement over that disclosed in a prior application of Mr Hall. The main object of the present invention is to increase the turning effect by the use of impact wheels instead of troughs, the motion of the wheels being communicated to the revolving frame so as to increase the rotative movement of the latter

MACHINE FOR EXTRACTING ESSENTIAL OILS FROM CITRUS FRUITS.—WALTER A D ALLPORT and THOMAS J W. C DAVENPORT, Roseau, Dominica, British West Indies This invention provides a machine for extracting essential oils from the outer rind of citrus fruits, such as lemons, oranges, limes, etc., and arranged to insure a continuous operation, thus permitting the handling of a large number of fruits in a given time, and insuring complete extraction and gathering of the oil without injury to the fruits

VACUUM STOCK THICKENING AND WASHING MACHINE.—T E WARREN, Ticonderoga, N Y This invention pertains to paper-making machinery The aim is to provide a thickening and machine arranged to separate water from fibrous material without the loss of the finer fibers and other minute particles, to produce a stock of uniform consistency and to permit convenient adjustment for producing a stock of a thicker or a thinner consistency, according to the nature of the fibrous material to be treated

STOP VALVE AND TAP.—J T SHELDON, "Olgate," Fernhill Street, Fernhill, New South Wales, Australia The purpose of the inventor is to provide a simple and effective means of preventing the escape of water, steam or other fluid normally controlled by a valve, when the cover thereof is removed, in order that the internal parts and mechanism may be withdrawn for examination, replacement or repair

AIRSHIP PROPELLER.—HOMER A KING, P. O. Box 474, Colton, Cal. The invention illustrated by the accompanying engraving has for an object the provision of a novel form of propeller having a double set of blades, one set mounted on a rod and the other set mounted on a sleeve carried by the rod, the propellers being oppositely inclined, and being



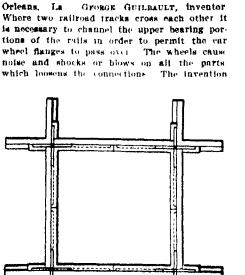
AIRSHIP PROPELLER.

arranged to revolve in opposite directions A further object is to provide an auxiliary propeller, which is designed to give a motion at right angles to the first named propellers Another object is to provide means for operating the propellers simultaneously, and for throwing the auxiliary propeller out of gear when desired

DRESSER FOR BAND SAWS.—F P SMITH, Baypoint, Cal This improvement provides an attachment to the usual grinding machine, the operation of which results in removing the burr at the edge of the face of the teeth, and to reduce the teeth to the same spread; provides means for dressing the sides of the teeth subsequent to grinding, and to accomplish the same automatically, and to shape the sides of the teeth to conform with the set thereof, and provides means for regulating the pitch and spread of the grinding members.

Railways and Their Accessories.

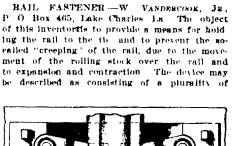
NOISELESS RAILROAD CROSSING.—AL FRED D DANZIGER, 204 Carondelet Street, New Orleans, La GEORGE GUILBAULT, Inventor Where two railroad tracks cross each other it is necessary to channel the upper bearing portions of the rails in order to permit the car wheel flanges to pass over The wheels cause noise and shocks or blows on all the parts which loosens the connections The invention



NOISELESS RAILROAD CROSSING

overcomes these objections by providing each rail adjacent the point of intersection with a pivoted lever, there being a pair of intersecting levers at the intersection of two rails A bell-crank lever is pivoted to each first mentioned lever as in operative relation with a sliding block adapted to engagement with the other intersecting lever whereby the car wheels pass over the top of this lever and do not engage the channels of the rails A railroad cross ing provided with this invention is shown in the illustration

RAIL FASTENER.—W VANDERCOOK, JR., P O Box 465, Lake Charles La The object of this inventor is to provide a means for holding the rail to the tie and to prevent the so-called "creeping" of the rail, due to the movement of the rolling stock over the rail and to expansion and contraction The device may be described as consisting of a plurality of

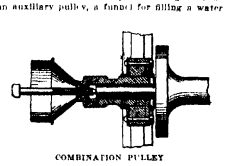


RAIL FASTENER

pairs of gripping jaws, one member of each pair arranged one on each side of the rail, and operated by the longitudinal movement of the rail The arrangement of rise substantially parallel with the length of the tie, and with the grain of the tie, prevents any lateral movement of the anchor plate and the spikes at the plate corners assist in this as do the center spikes The engraving is a plan view of a portion of the rail provided with the improvement

Pertaining to Vehicles.

COMBINATION PULLEY FUNNEL AND STRIPPING JACK.—TRESHAM F HUTCHINGS, Stone Ford, N Y The principal object which the present invention has in view is to provide a device constructed to permit being used as an auxiliary pully, a funnel for filling a water



COMBINATION PULLEY

or gasoline tank, and means for stripping a tightened wheel from the axle bearing The view shown in the accompanying engraving represents a vertical cross section of an automobile wheel and the axle thereof showing a pulley constructed and arranged in accordance with the present invention as operatively connected therewith When the pulley is not employed, it is removed from the axle and carried as a separate tool in the body of the vehicle It may then be used as a funnel for filling the tanks.

NOTE.—Copies of any of these patents will be furnished by the SCIENTIFIC AMERICAN for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.



Better Than Nails

After fitting the corners of a picture frame or the joints of other light work, have you ever ruined the whole thing by splitting it with a nail? Then you've had need for

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And is just as handy as nails or string. Put up in air-tight bottles, it positively cannot dry out. The last bit you scrape from the bottle with the metal spreader is as good as the first.

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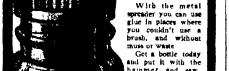
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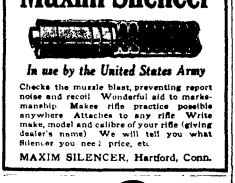
Maxim Silencer



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NEW BOOKS, ETC.

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The financial aspects of modern warfare are considered in the present instalments, Nos 34 and 35, of the Handbuch. Excellent tables are published, which show the rise and fall in military expenditures during the last few decades. It is particularly interesting to study the influence which actual warfare has had upon the expenditures. The whole article is a warning against thoughtless comparisons. Inasmuch as all statistics are based upon different facts. In the article on the French army, a very complete and accurate description will be found of the geography of France in its relation to French military affairs, French railways and fortresses, French cable and telegraph lines, and the history of the French army. The discussion of the army itself begins with an excellent review of its development from the days of Louis XIV, and concludes with an exhaustive description of its present status. It enumerates the difficulties that beset the commanding officers, and shows on the basis of numerous tables, the composition of the peace and war footings, the organisation of the naval arm of the service, the military budget and character of the uniforms. French naval and colonial affairs are treated in the same manner. Flying machines also find a place in these two instalments, treated, of course, from a military standpoint.

SEEING EUROPE BY AUTOMOBILE By Lee Meriwether New York The Baker & Taylor Company, 1910 12mo; 415 pp Price, $2 net.

The author once wrote a book on how to see Europe on fifty cents a day, but he has evidently been blessed with a change of fortune in the last quarter century, for now he travels in a two-seated, four-cylinder 24 horse-power roadster, but the passion for travelling cheaply has been far from being quenched by comparative affluence. The author details with great precision the distances traveled and the things seen. It is an instructive book for all those who are thinking of taking the trip. There is an excellent map in the back. It is well illustrated.

CHARACTERISTICS OF EXISTING GLACIERS By William Herbert Hobbs, Professor of Geology in the University of Michigan New York The Macmillan Company, 1911 8vo, 301 pp, illustrated Price, $3.25 net

Prof Hobbs discusses his subject under three heads, mountain glaciers, Arctic glaciers, and Antarctic glaciers. He points out that a mistake is made in treating of glaciers as if all were governed by the same laws. He prefers rather to emphasize the fact that the laws governing their nourishment and depletion are far from identical. The division is broadly made between those glaciers which cover completely a large portion of rock surface, having the form of a shield or flat dome, and the remaining types which may be designated as mountain glaciers. Small ice caps occupy an intermediate and transitional position between these two types. The language and treatment is rather technical, but well repay the slight study necessary for the layman to understand its terms. Since, as we are reminded by Sir Charles Lyell, "The present is the key to the past," the study of glacial conditions never fails to create enthusiasm and broaden the understanding.

THE SCIENCE OF CURRENCY AND CENTRALIZED BANKING By Herbert D Miles New York Rand-McNally Press, 1911. 16mo; 47 pp

The author is an ardent champion of the Aldrich plan, which he designates as a work of genius, profound, far-reaching, yet simple and sincere. He reviews the banking systems of the world, compares and contrasts the European credit instruments and discounts with those of the United States, and proceeds to an examination of American methods, their relation to gold reserves and their efficiency in crises. The treatise exhibits some clear thinking and much subtlety of condensation. It aims to give the gist of what has recently been issued by the National Monetary Commission through its various published papers.

CONCRETE MONUMENTS, MAUSOLEUMS, AND BURIAL VAULTS By A A. Houghton. New York The Norman W. Henley Publishing Company, 1911. 65 pp. Price, 50 cents.

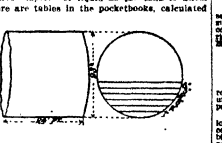
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(12546) F. B. T. says: A short time ago I bought a barometer, which appears to be a very good instrument, but its action is a little puzzling, and I wonder if you can give me a helpful suggestion. The only fine that the barometer has gone up to 30 was during the extremely wet weather we had a few days ago; and in the dry season which we experienced during the summer, it ranged around 29½ or thereabout. It has never gone much below 29 in spite of the fact that we have had some very heavy storms. I notice in the daily paper that the government barometer at the Springfield armory seems to agree fairly well with mine in its reading, but in that case, it would seem to me that the lettering, which I have noted, is very misleading. I had the impression that a low barometer meant stormy, bad weather and a high barometer fair, dry weather. I would be glad to have you give me any suggestions, either through your paper, for which I am a regular subscriber, or by mail, as you may prefer. A The words Stormy, Rain, Change, Fair, Very Dry, have no meaning whatsoever upon a barometer, and it is very strange that they should be still placed there, since every maker of instruments knows that they are without meaning. The figures around the circles are inches of mercury. In good weather at the sea level the barometer will be found to indicate about 30 inches. A falling barometer indicates the approach of a storm, a rising barometer indicates the approach of continuance of good weather. A high barometer indicates the continuance of the present state of the weather, good or bad. A rapid rise or fall indicates high winds. If you live about 500 feet above sea level, the barometer will be one inch lower than it is at the same time at sea level, and at 1,050 feet above sea level the barometer will be two inches lower than at sea level at the same time. If your barometer does not agree quite closely with the government instrument in the same neighborhood, it is probably out of order and should be tested. The high school in your city doubtless has a good barometer, and the teacher of physics there will be very willing to give you his assistance and advice in the matter. A barometer may be expected to change two inches or thereabout in centers of weather. The best test for a barometer is to hang it by the side of a reliable barometer and compare the reading of the two for some weeks.

(12547) R N M says: Would you please give me a rule or formula for finding the capacity of a cylindrical tank when lying on its side for each inch of the diameter? I desire to make a gage so it can be read at a glance, giving the number of gallons by each inch. The tank is 24 feet long and 93 inches in diameter, with rounded ends, but for our purpose these ends can be considered as square with the diameter. A There is no simple formula for the volume of the successive "layers" of liquid as the tank is filled. There are tables in the pocketbooks, calculated



from the mathematical formulas, which give the area of segments in terms of theorem of the circle. The volume of your tank, 93 inches diameter, 288 inches long, is

$$\frac{93 \times 93 \times 0.7854 \times 288}{231} = 8{,}470 \text{ gallons.}$$

Now, to find the depth to which 100 gallons will fill the tank, we must find the height

$$\frac{100}{8470}$$

of a segment —— of the area of the whole

93-inch circle, or 0.0118 × area of circle. From a table of circular areas and segments (see Kent's "Mechanical Engineer's Pocketbook") we find that a segment having an area of 0.0118 times the area of the circle, would in a circle of 1-inch radius, or 2.14 inches area, have an area of 0.0118 × 3.14, or 0.037 inch, and a height of 0.073 inch. In a 93-inch circle the height of the segment would be 0.073 × 93, or 6.78 inches; so that filling your tank to 6.78 inches depth will measure 100 gallons. Similarly, you can calculate (with the aid of the table) the heights for 150, 200, and all other numbers of gallons, and make your scale accordingly.

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The Current Supplement

THERE economy is used, not on a mere policy of doing things cheaply, but on a systematic and scientific plan of controlling value received against price paid. How the Pennsylvania Railroad guards against loss by poor materials is told us in a valuable article in the current issue of the Supplement.—Prof. Turner's article on The Great Star Map reaches its sixth instalment. Balloonists have observed that to them the surface of the earth appears bowl-shaped. The cause of this is explained by Dr. Charles Forbes of Columbia University.—The sewage purification industry is far from having become standardized. A new apparatus which has been found to give much satisfaction is described by our Berlin correspondent.—In a very excellent article Mr. A. J. Jarman gives practical instructions for the amateur, which will enable him to prepare and mount photographs upon watch lids and the like.—The farmer will find in this number useful information regarding the construction of concrete silos. In these days of remarkable technical development and substitution of all sorts of artificial products for the natural, it is refreshing to note occasionally that for some particular purpose some simple product of nature is still found indispensable. The use of spiders' threads in optical instruments is discussed by W. F. Rigge, who tells us how, on a certain occasion, an entire department of Creighton University Observatory was put out of commission for want of a spider's thread.—Many are the attempts made by amateurs to solve certain mathematical problems, such as the trisection of the angle. It is unfortunate that much ingenuity should be wasted upon such efforts, and discussion of this topic by N. P. Dupuis, should prove very beneficial in clearing up an unfortunate misunderstanding. The problems as ordinarily stated are incapable of solution, not because of any intrinsic bar to such solution, but because of the artificial restrictions imposed by the injunction that the problem shall be solved entirely by Euclidian methods. Remove this restriction and the problems can be solved without difficulty. Insist on this restriction and it can be proved that the problem is incapable of solution.—The influence of the mercury vapor lamp upon the eye is discussed in a note by Dr. W. H. Williams.—We think of surgery as a destructive measure, which may remedy an ill by removing a part of the body which nature intended to be retained. Some of the newest developments bear the promise of constructive work, in which a deficient organ is replaced by a healthy one derived from some external organism. This subject is discussed in an article derived from *La Nature*.—Some interesting new light has recently been shed upon the process of fertilization by researches on the influence of radium upon the frog embryo. A short account of this work is given in the current issue.—From the fertile mind of Svante Arrhenius we have an article on the Fate of the Planets.

The Disposition of Guns in the Dreadnoughts

(Concluded from page 318.)

The second turret from forward is superposed, as is also the second from the stern, the object in each case being to increase the volume of fire along the line of the keel. The fourth turret from aft is also superposed above the third, but here the saving of length was the object in view, as these guns do not bear aft. (Fig. 12.)

The only other six-turret "Dreadnoughts" with a 100 per cent broadside are the Argentine ships "Moreno" and "Rivadavia." These vessels, with twelve 12-inch guns, have four turrets on the middle line and two echeloned (Fig. 13). There has been, and probably will continue to be, much controversy as to which is the more effective arrangement; but the fact remains that the "Wyoming" can cover an arc of 95 degrees on either beam with all twelve guns, while in the case of the Argentine ships this is 10 degrees less. For ten guns the respective figures are 130 degrees and 90 degrees, and for eight, 135 degrees and 135 degrees. The Brazilian battleships "Sao Paolo" and "Minas Geraes" have their guns arranged on a similar plan to the Argentine vessels, but the superstructure divides the echeloned turrets, which are therefore not available on both broadsides.

For practical purposes the French battleships "Jean Bart," "Courbet," "France," and "Paris" are similar to the Brazilian, two turrets being mounted forward and aft (with one superposed in each case), and two abreast amidships. (Fig. 12.)

We now come to a striking variation in design. The German battleships "Rheinland," "Posen," "Nassau," and "Westfalen" all have twelve 11-inch guns as their main armament; but they are so disposed in their six turrets that only eight guns bear on the beam. (See Fig. 15.) It was at first thought that this system was due to a misapprehension as to the system of naval tactics which the "Dreadnought" principle involved, but this is hardly borne out by the fact that the arrangement is being strictly adhered to. The "Thüringen," "Helgoland," "Ostfriesland," and "Oldenburg" are armed with twelve 12 2-inch guns apiece; but the distribution remains the same. Although, therefore, these ships carry as many big guns as the "Wyoming," the latter is 50 per cent superior on the broadsides. The German vessels, with their twelve guns, are no better as line-ahead broadside fighters than the "Michigan," the British "Invincibles," or even the 15,500-ton Spanish Espanas—leaving questions of speed and protection out of consideration.

Curiously enough, the Japanese have also adopted this system, at least for their first two all-big-gun ships, the "Kawachi" and "Settsu," for the distribution of the 12-inch guns in these ships is the same as that of the 11-inch and 12.2-inch in the German vessels. The average student of the naval war between Japan and Russia will be hard put to it to find any justification for this subordination of the broadside, and it is more difficult to understand since it has been reliably stated that all the data gleaned by the Japanese were placed at the disposal of the British authorities. The same tactical data could hardly justify the "Orion" (Fig 7) and at the same time excuse the "Kawachi" (Fig 15)

Summarizing these details, it will be found that the total number of heavy guns mounted in the 68 ships of the "Dreadnought" era whose details are known is 723, a total that could not have been attained with fewer than 181 ships of the pre-"Dreadnought" era. The ownership of the guns, as well as certain other details, is shown in the following table:

Countries	Number of Ships.	Details Known of.	Guns Mounted (Inches Caliber)					
			14 Inch		12.5-in.	12-Inch	11-Inch	
			Total.	Broadside.	Total.	Broadside.	Total.	Broadside.
Great Britain	28	27			104	104	252	236
United States	12	10	91	80			100	100
Germany	21	6					48	32
Italy	4	4					61	51
Russia	4	4					48	48
France	4	4					42	42
Spain	3	3					24	24
Argentine	3	3					24	24
Brazil	3	3					24	20
Japan	2	2					24	24
Austria	4	3					24	24
Turkey	3	0						
Chili	2	0						
Totals	100	68	91		104		543	56
Number of guns in three-gun turrets							111	
Number of guns in center-line turrets			90		104		407	90

It will be noted that as the caliber increases so does the desire to place all the guns on the middle line.

A Political Laboratory

A POLITICAL laboratory has been established at Columbia University through the generosity of Patrick F. McGowan, ex-president of the board of aldermen, and will be available at once for the 180 students of politics at the university. Sufficient money has been given by Mr. McGowan to maintain the laboratory for a year, and it is hoped that the city will make an appropriation for its support thereafter. The laboratory will be under the direction of Professor Munro, who has been appointed to the chair of municipal government. Its purpose is to study the practical problems of city government, and to train students for the public service. Professor Munro will have associated with him a number of lecturers, who will be men actively engaged in the practical work of municipal government.



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About Remembering

By ELBERT HUBBARD



HENRY DICKSON
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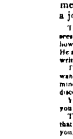
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tory for two years. Its purpose is to bring the students in contact with the documentary sources of information, and in addition to place the collection of materials at the disposal of the debating teams of the university.

The laboratory will consist of a select library covering the field of American government and politics. Newspapers from all parts of the country will be kept on file for a certain period and afterward clipped and indexed. A large number of weekly and monthly magazines will be kept on file. Then there will be such books of reference as the American Year Book, the Cyclopædia of American Government, Beard's Digest of Short Ballot Charters, and the like. The laboratory will also contain a large number of federal, state, and municipal publications, which will include the Congressional Directory, Congressional Record, Labor bulletins, consular reports, reports of civil service commissions, the constitutions of all states, legislative manuals, sample ballots, election laws, and, in fact, everything that the student in politics needs Special subjects will also be cared for as well and extensive collections in the field of politics will be made.

A New Opportunity in Industrial Education

THE first requisite of education should be that it helps the boy to make a livelihood Whatever else it may do it should at least train him properly for some occupation Education which thus ministers to self-support is attracting wide attention, and the need for the development of trade schools in all important industrial centers has become everywhere recognized

In this matter of trade schools, Boston merits particular attention as it is especially in advance in this direction The most recent accession to the list of existing educational institutions is the New Wentworth Institute This most important addition to the present educational facilities of the Commonwealth, which are so amply provided and so excellent in many other directions, furnishes new and very much needed opportunities in the industrial field where at present there are none

The new Trade School was founded by the late Arioch Wentworth, a citizen of Boston, who left over three and a half million dollars for the purpose of "Furnishing Education in Mechanical Art."

The aim of the new school is to give young men practical instruction which will enable them to enter industrial life prepared to do and earn from the moment of graduation These courses are for those who wish to become skilled and intelligent artisans and industrial workers, and also for those who wish to prepare themselves for more responsible positions in mechanical and manufacturing plants.

"To furnish education in mechanical arts" is the statement of purpose made by Mr Wentworth in his bequest This phrase defines both the general field of education which the new school occupies, and it also defines with equal definiteness many of its essential characteristics It is a school to furnish education in mechanical arts, in other words, a school to train young men for a higher degree of efficiency in mechanical trades requiring both skill and intelligence than they may attain through any opportunities which are now open to them

The End of the British Naval Airship

THE first naval airship built for the British government by Vickers, Sons & Maxim, at a cost said to be $400,000, was wrecked in Barrow in Furness on September 24th It seems to have been ruined from the same cause that brought about the destruction of so many Zeppelin craft, namely, the impossibility of preventing the airship from being battered against its own shed when half drawn out

The new dirigible, which has been fully described in these columns, never really flew It was taken out on May 23nd, but failed to ascend The builders thereupon undertook to lighten it, and the 23rd ult. finally accepted it on September 23nd.

Electricity

Queen Mary's Fan.—An electric fan has recently been made by the General Electric Company for Queen Mary of England It has been designed to harmonize with the royal toilet articles. It is mounted in gold, and is provided with an ebony switch The fan will be used to dry the Queen's hair, after a shampoo.

Electric Lamps Here and Abroad.—There are in Boston, says the *Electrical Review and Western Electrician*, the equivalent of 1,232 sixteen-candle power electric lamps per thousand of population, in New York 859, in Chicago 730, and in San Francisco 660. European cities show much smaller figures, St. Petersburg having 440, Vienna 246, Paris 185, and London only 4.

Electrocuting the Codling Moth.—The owner of an apple orchard in Spokane has constructed an apparatus with which he hopes to rid his orchard of the codling moth. He uses electric incandescent lamps, surrounded by a metal netting, which is charged with electricity. The moths attracted by the light strike the wire and are instantly killed. The cost of the storage battery and lamps is comparatively small

Electricity from Peat in Canada.—The Canadian government, wishing to arouse interest in the utilization of peat, has built a plant at Ottawa and secured a peat bog of three hundred acres near Alfred, Ontario The plant is equipped to make producer gas from the peat, which will be used in a 60-horse-power four-cycle gas engine, directly connected to a 50-kilowatt dynamo It is estimated that there are 36,000 square miles of peat in Canada, which would yield 28,000,000,000 tons of air-dried peat, which would be equivalent to 14,000,000,000 tons of coal To demonstrate the commercial practicability of utilizing peat for power purposes a building adjoining the Ottawa plant will be fitted up as an ore-dressing laboratory and will be operated by the electricity generated from the peat

Wireless Telegraphy in the Congo.—A recent consular report states that within five years there will probably be 200 wireless telegraph stations in operation in the Congo A Telefunken station is in operation at Boma, the capital of Belgian Congo, and a station of the French Ferrier type at Banana, the principal seaport Each of these is of 1½ kilowatts, but the latter will shortly be increased to 5 kilowatts. The Telefunken engineers expected to erect in September a 5-kilowatt station at St. Paul de Loanda, in the adjoining Portuguese territory at Angola, after which a station was to be established at Leopoldville, on the Congo River. If these stations prove successful, an extensive series of stations will be erected all along the Congo and Kassi rivers The French company expects in the near future to erect a station at Loango, French Congo, and later stations in all the French West African colonies

Electrical Fires in Chicago.—Some interesting facts gathered from the annual report of the city electrician of Chicago are quoted by the *Electrical World* These relate to the electrical inspectors' reports on electrical fires in that city during the year 1910 A table is given to show that there were eighty such fires, with a total loss of $37,550, a small amount compared with the total fire loss Of this amount, one fire caused a loss of $30,000, the cause in this case being the breaking of a lighted portable incandescent lamp, the sparks from which fell into gasoline and oil on the floor The next largest loss was caused by a fire due to sparks from a defective socket falling on chemicals. This defective socket was suspended over the chemicals by lamp cord extended through a metal hood. The loss was estimated by the inspector at $5,000. In all other cases the loss was comparatively slight Of the eighty electrical fires, fifteen were due to low-tension wires short-circuited, nine to motor burn-outs, seven to sparks from motors, five to overheated flatirons, five to wires grounded in conduits, four to low-tension wires grounded, four to defective rheostats, four to lightning, four to short-circuits at fixture outlets, four to breaking of incandescent lamps and the rest to a variety of causes.



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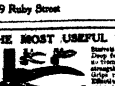
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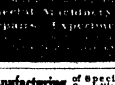
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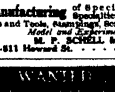
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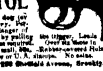
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A Sewer System for Tokyo.—A consular report from Japan states that the city of Tokyo will install a complete system of modern sanitary sewerage before the opening of the world's exposition, which is to commemorate the fiftieth anniversary of the crowning of the Mikado Tokyo has a very large area in proportion to its population, viz., about 100 square miles; hence the installation of sewers will be an immense undertaking The cost is estimated at from $17,000,000 to $20,000,000

The Dreadnought "New York."—Following the "Connecticut" and the "Florida," the keel of the largest of our battleships, the "New York" has been laid at the New York Navy Yard on the same ways on which the two first-named ships were built, and excellent progress is being made upon the ship's floor. A touch of sentiment was lent to the occasion by the fact that the first bolt was put in place by the young grandson of the late Rear Admiral Sampson The "New York" will be 573 feet long, 95 feet, 2 inches broad, will displace 27,000 tons, and will carry ten of the new and very powerful 14-inch rifles

Heat of Exhaust.—Experiments were recently made by one of the leading Swiss firms as to utilizing the waste heat of exhaust gases from internal combustion motors In the present case the Sulzer-Diesel motor was used Water is heated by the exhaust, and the exhaust gases are sent through a set of tubes placed inside a water tank Air for various purposes can be readily heated, for drying ovens or other purposes. One of the main difficulties was to make the tubes of a suitable material so that the exhaust gases would not attack it However it was found that certain special kinds of cast iron will serve the purpose very well.

"Spotting" by Camera.—At present the fall of the shots in target practice is observed from the tops of the cage masts of our battleships and cruisers; the "spotter" noting through his glasses whether the shot falls short or over, or has a deflection to right or left Lieut Com Cleland Davis, whose torpedo has been illustrated in this journal, has invented a method of spotting by the aid of the camera The splash is photographed and in a few seconds the negative is developed The necessary corrections in the range and deflection are then made, and it is stated that the operations are so speedy that there is practically no delay as compared with the present methods of spotting

Lubricating Oil Tests.—From the fact that it is a common practice to use lubricating oil again after filtering it, Messrs Sabatie and Pellet found it of interest to see whether such used and filtered oil showed any great difference from fresh oil Analyses showed this following results The density of the oil is somewhat increased this being no doubt due to the evaporation of volatile portions of the oil The flash point and combustion are a few degrees higher About the same viscosity was observed in both cases The acidity of oils is not changed but the percentage of vegetable or animal oil in mixed oils is considerably lessened. From a practical standpoint the used and filtered oil keeps all its lubricating qualities, provided that care is taken to secure a good filtering so as to remove all the solid particles

Double-decking a City Street.—Chief Engineer Goodrich of the Bureau of Encumbrances, of the Department of Highways, New York, has proposed a plan for the double-decking of 42nd Street, New York, between 5th and Lexington Avenues The street is one of the most congested in the city, there being probably no place in the world where so many systems of transportation center as here The double-decking of the street will give an opportunity for separating the traffic, to say nothing of at once doubling the capacity of the street. Here is a problem which will have to be met and successfully solved as the modern office building twenty to thirty stories in height gradually replaces the older building. Some of the down town streets of New York are already congested almost to a standstill.

Science

An Anthropological Expedition to New Guinea.—*The Geographical Journal* announces that the Committee for Anthropology at Oxford is about to send an expedition for anthropological research to the little known D'Entrecasteaux group, off the eastern end of New Guinea It will be under the leadership of Mr D Jenness, of Balliol, who won distinction at the University of New Zealand before proceeding to Oxford, and who has had practical experience of life in the bush

Ostia.—Director Marino Vaglieri of the National Museum at Rome has opened several Republican tombs in the course of his researches at Ostia, once the chief port of Rome at the mouth of the Tiber A fountain statue of Aphrodite came to light in the Roman theater It is recalled that the Townley Venus in London was found at Ostia The new one resembles another statue of equally Praxitelean style which the late Professor Furtwaengler coupled with the London figure, namely, the Venus of Arles

Horace's Villa.—The exploration of Horace's villa in the valley of the Licenza near Mandela has been resumed by A Pasqui Two sites claim the honor of this name and have divided the pilgrims to the Latin poet's house into camps Both offer scanty remains of Roman country houses Whether Pasqui will find any relics as old as the reign of Augustus is very doubtful But his villa ruin will serve a purpose if it only entices more tourists out of the hot streets of Rome to the outdoor charm of the Sabine Hills

Distribution of the Elements in the Earth's Crust.—The solid crust of the earth with a specific gravity of only about 2.5 as against 5.7 for the entire globe (crust and liquid or semi-liquid interior) is said by Rosenbusch to consist of the various elements in the following proportions by weight Oxygen 47.29 per cent, silicon, 27.21; aluminium, 7.81, iron, 5.46, calcium, 3.77, magnesium, 2.68, sodium, 2.36, potassium, 2.40 hydrogen 0.21, titanium, 0.33, carbon, 0.22, chlorine 0.01, phosphorus 0.10, manganese 0.08, sulphur, 0.02, barium, 0.03, chromium, 0.01

To Remove Tattoo Marks.—Once tattooed, always tattooed, was formerly the rule, but a French army surgeon, Dr Tranchant, has discovered a method of removing tattoo marks, whether made with India ink or lampblack. According to *La Nature*, the process consists of first rubbing the skin until a thin layer of the surface is worn away, then applying a mixture of lime, slaked just before use, and powdered phosphorus The tattooed part having been coated with this paste, a piece of gauze is laid over it, covered with a bandage The dressing is removed after forty-eight hours The scab is allowed to dry in the air, and comes away in about a fortnight, without leaving a scar If any trace of the tattooing then remains, the treatment is repeated Dr Tranchant claims to have applied this treatment in a great many cases, with perfect success

A Cold Winter in the Levant.—According to a report from the American consul at Aleppo, last winter in that vicinity was one of almost unprecedented severity The snow was from two to four feet deep on the level and covered the plains of the entire country around Aleppo, as far south as Bagdad, and north and east to Diarbekir and Mosoul, while the mountainous districts and the railway from Aleppo to Beirut were entirely blocked for a period of about two months, not even the mails arriving for some four weeks If, as we infer from this statement, snow fell in Beirut, it was the first since meteorological observations were begun there upward of thirty-five years ago It is stated that drivers and travelers were frozen to death on the roads, many flocks of sheep perished together with the herders, and numerous families of Bedouins were found frozen in their tents. It is estimated that between 50 and 60 per cent of the sheep were frozen or starved to death, so that there will be a great reduction in the export of skins, wools and stock for meat purposes during the next year or two The olive orchards were also badly damaged.



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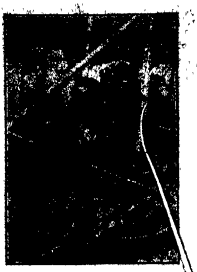
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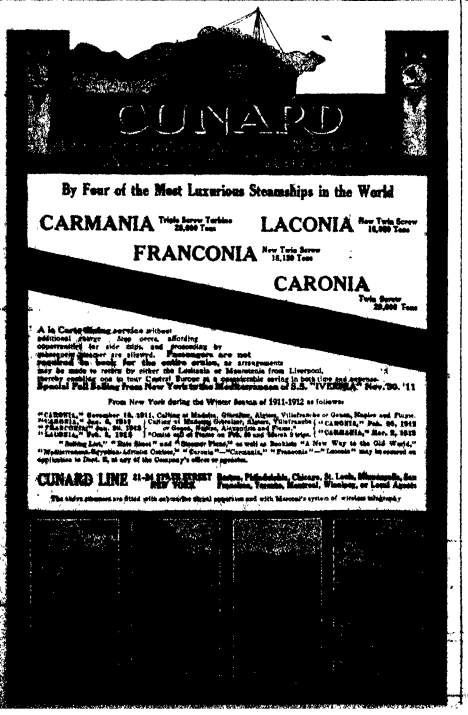
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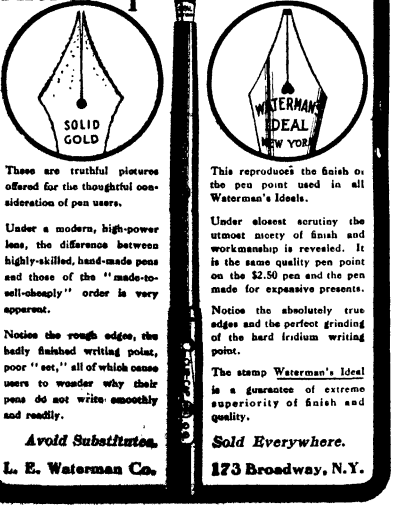
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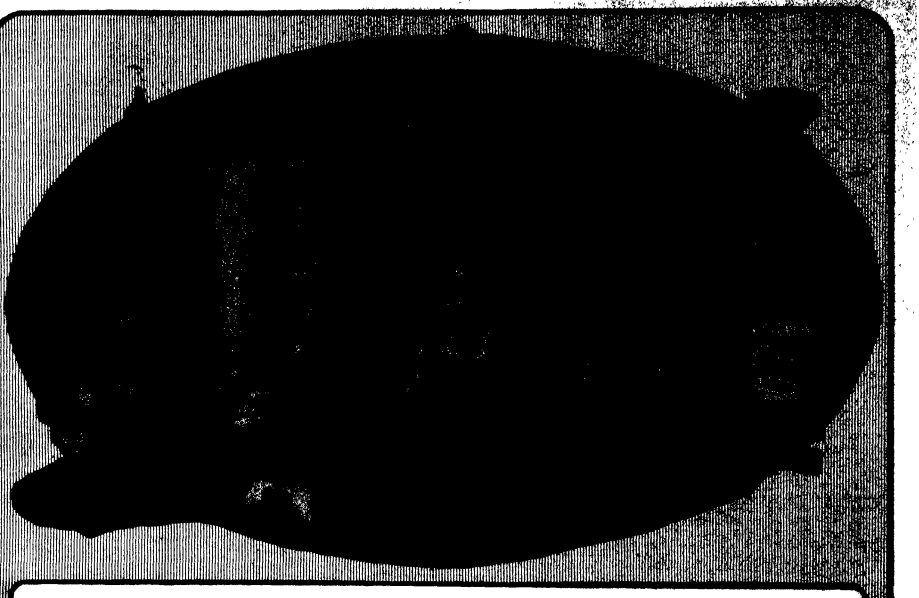
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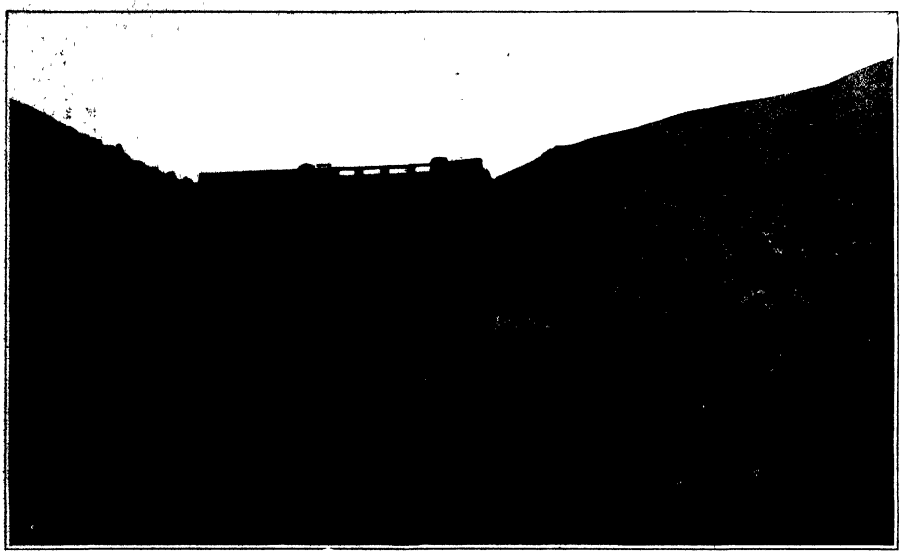
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SCIENTIFIC AMERICAN

THE WEEKLY JOURNAL OF PRACTICAL INFORMATION

VOLUME CV. No. 16.] NEW YORK, OCTOBER 14, 1911 [15 CENTS $3.00 A YEAR



View from below dam, showing huge sections of the wall pushed bodily down stream.

The Failure of the Austin Dam

A Call for State Legislative Control

THE complete failure of the Austin dam, with its resultant loss of property and human life, has naturally drawn attention to the early history of this structure. The dam was constructed in the year 1909, to replace a smaller dam higher up stream built about eleven years previously, for the purpose of impounding the water required for a pulp mill. The width of the valley at the point where the new dam was placed is 250 feet, and the reservoir was designed to impound 200,000,000 gallons of water, with the spillway 42 feet above the level of the valley. The width of the dam at the top was 2 feet 5 inches, at the bottom 36 feet. The length of its upper face was 544 feet. The rock foundation of the valley consists of horizontal layers of sandstone with shale sandwiched in between. The building of the dam, which contained about 16,000 cubic yards of concrete, was begun in May and completed about December 1st, 1909. In preparing the foundations, about 6,000 cubic yards were excavated, and an earth embankment was laid against the upstream face of the dam at a slope of 3 : 1, reaching within 27 feet of the normal water level.

The concrete structure was reinforced with twisted steel rods 1¼ inches in diameter and 25 feet long, placed 2.7 feet apart. On either side of the spillway a bulkhead was built, which also was reinforced with millinch steel rods, as was the top of the dam. Very significant is the fact that, upon completion of the dam, there was found to be a crack extending from the top to the ground level, and in December, 1909, a second crack appeared, about January 17th, 1910, the weather was warm, and abundant rain fell. On the 21st of January, the dam was overflowing. On Monday, the 23rd, water was found to be leaking from the toe of the dam. It was suggested at the time that the failure of the dam to withstand the flood of 1910 was due to two causes. First, the great bulk of the hurriedly built concrete, some of which was laid in freezing weather, and completed only six weeks before the time when the maximum pressure occurred, secondly, the seepage of water through the rock strata under the dam.

As far as we can learn, the work done upon the dam at this time in the way of investigation of conditions and of provision against further damage, was altogether inadequate, particularly in view of the fact that heavy seepage had taken place through the porous material below the foundation. The least that could have been done would have been to sink a curtain wall through the underlying rock, etc., carrying it down everywhere to a thoroughly impervious stratum. Failing this, the dam should have been abandoned altogether.

In the construction of storage dams, of whatever character, it is an axiom that there should be no suspicion whatever as to the impermeability, not merely of the dam itself, but of the natural formation upon which it is laid. There is no mystery about the construction of watertight dams. The problems connected with their foundations and with the stresses in the dams themselves are perfectly well understood among competent engineers, and have been so understood for a long period of time. We know of no engineering work regarding which the possibilities of failure are so many, and their results so serious, as that which has to deal with the impounding of vast quantities of water by the erection of artificial barriers. Thanks to accumulated stores of knowledge, and to the very thorough training, theoretical and practical, to which the competent civil engineer is subjected, both at the engineering schools and colleges and in his subsequent career, there is abundance of high class professional skill available for those individuals or corporations who wish to undertake the construction of works of this character.

One of the most important lessons of this disaster is that which teaches the necessity for the employment of engineers skilled in this particular branch of work. Another lesson is that when the engineer has been engaged, he should be left an absolutely free hand in determining the character of the construction that should be employed. To engage an engineer to design a dam of importance and then impose a limit of cost is to tempt him to play fast and loose with the ethics of his profession, and imperil the safety of the proposed structure.

The photographs of the wrecked dam and the devastation which was caused by the flood of water that swept through the valley below tell their own story so clearly that but little comment is necessary. If we bear in mind that seepage was occurring below the foundation, the probable sequence of events, as the dam gave way, is easy to understand. We spoke early in the present article of certain cracks that appeared when the dam was first filled with water. Very significant is the fact that one of the largest breaks in the dam wall occurred along the very lines of these old fractures. Settlement due to gradual washing out of the underlying porous material, coupled with changes of temperature, may have induced the original cracks. Further washing out below the foundations would cause these cracks to become complete lines of cleavage. Then it was that the loss of transverse

(Continued on page 356.)

SCIENTIFIC AMERICAN

Founded 1845

NEW YORK, SATURDAY, OCTOBER 14, 1911

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The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are sharp, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

The purpose of this journal is to record accurately, simply, and interestingly, the world's progress in scientific knowledge and industrial achievement.

Mind and Mechanism

It has been pointed out that the mechanical aids which man has devised to assist him in his varied pursuits of daily life are subject to an evolution precisely similar in character to that which governs the development of living organisms. In this evolution of our mechanical adjuncts there is a tendency to transfer to them a greater and greater share of the functions originally performed by man himself. Thus the rude implements of primitive man, the cudgel, the stone hammer, may be regarded as a modified arm, a fist remodeled to adapt it to a special end. The energy for the action of such simple tools is supplied directly by the operator, without undergoing any fundamental modification on its way to the point of application. Later came levers, engines of war, and various instruments of more complicated character. Here the energy is in most cases still derived from the primitive source, the human body, but its factors undergo various changes, as in the lever, which, by lengthening the path of travel of the point of application, secures a proportionate gain in the mechanical power available—or in the crossbow, which stores up in the form of elastic strain the work done by the muscles of the arm. This pent up energy, when suddenly released by the action of the trigger, speeds the deadly missile at the foe. The bowman, having in a separate act charged his weapon with the strength of his arm, is, in the second stage of the process, free to give his whole attention to the aim.

But man early found means to supplement the limited powers of his body from more lavish sources —the wind, the running stream, were pressed into his service. Then came explosives, and last of all the patient steam engine. And now becomes apparent a new feature. The new servant does more than merely replace the hand, the arm, or the feet that carry us from place to place. The inventor has, as it were, breathed into his creature a part of his own sentient soul. In orderly sequence, and with a precision that defies imitation by human hands, a legion of tireless engines in the factories throughout our land perform innumerable tasks that seem to require the guidance of a reasoning mind. The co-ordination centers of the inventor's brain have, as it were, been implanted in the machine. Nor is this all. Such purely mental a task as numerical computation is now intrusted, with great saving of time and brain-fatigue, to the mechanical calculator. Indeed, a machine has been built, which, when given the premises of a problem, will, by purely mechanical manipulation, complete the argument and set forth the logical conclusion. This "logical machine," it is true, is at the present time but a scientific curiosity and perhaps will always remain so.

Coming right down to current events, a most instructive and interesting case is presented to us in the Doutre aeroplane stabilizer recently described in our columns. The action of this apparatus displays all the characteristic features of the "sensory motor circuit" of psychology. Throughout all the interactions of the individual with the external world there runs a cycle. The first link in the chain is, as a rule, a stimulus from outside, causing a "sense impression" in some one or other of our organs of special sense, such as the eye, the ear, or the tactile papillæ of the skin. Occasionally an "internal sense" such as our sense of orientation or equilibration may take the place of our consciousness of things without. In the last stage the cycle returns again to the external world, the action being now reversed, the organism reacting upon its environments. Intermediate between these two stages there is necessarily a connecting process, which may be intensely complicated, involving all the intricacy of a long chain of mental operations; in other cases the connection is at least seemingly simple. The sensory motor circuit appears most clearly in so-called reflex actions, for here the successive steps occur in immediate sequence. Thus a sudden loud report produces an instant quiver of the eye-lid; if through some accident the balance of our body is upset, reflex action, through the medium of our sense of equilibrium, located in the semi-circular canals of the inner ear, immediately calls out a righting motion in the requisite muscles. Consciousness does not necessarily enter into these effects, which, indeed, continue during the lighter stages of anæsthesia, but, as has already been indicated, conscious action is subject to the same cycle. This is obvious enough when the reaction follows close upon the stimulus, as, for instance, when the sight of some desirable object induces us to put forth our hand and seize it. But in the great majority of cases, in the infinite variety of our daily activities, the reaction is "delayed" and many complicated steps of mental and emotional experience intervene between the data furnished by our senses and the action based upon them. But however complex these data may be, involving often the entire previous history of the individual; however intricate the maze through which the mind weaves its thread from the entrance to the soul, a sense perception, to-the final goal, the reaction upon the environment: the same sensory motor circuit is discernible throughout. For all the contents of our mind are ultimately referable to sense impressions.

The Doutre stabilizer is equipped with an anemometer plate which responds to variations in pressure, thus, as it were, informing the apparatus of external conditions, just as our eye, our ear, our sense of touch, keep us informed of the state of the world around us. More than this, by a suitable mechanical connection, the stimulus thus applied to the anemometer, by relay action, sets free a store of energy which actuates an auxiliary motor. This reacts upon the environment in such a way as to preserve the aeroplane from accident. Furthermore, the Doutre stabilizer comprises an element which is the exact counterpart of some of our internal senses. The apparatus reacts not only to changes in external conditions, but also to changes of its own speed. A number of gliding weights are partially free to move relatively to the body of the aeroplane. According to the laws of dynamics, they will do so, owing to their inertia, as soon as the aeroplane suffers an acceleration. The relative motion of the gliding weights with reference to the body of the aeroplane is made to actuate the auxiliary motor, and again we have an exact counterpart of reflex action, designed to maintain the "life" of the machine.

Had the inventor set to work with the deliberate intention of preparing a mechanical model illustrating reflex action, he could hardly have produced a more perfect example than is presented to us in the Doutre stabilizer.

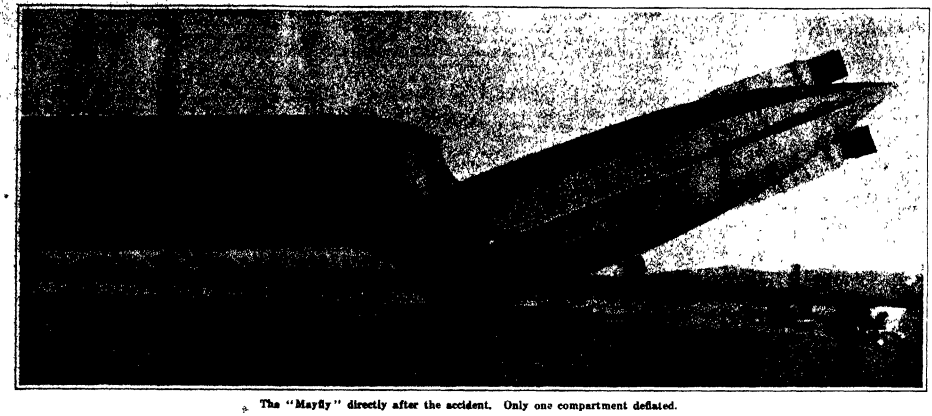
New York's Budget Exhibit

THE necessity for technical men and scientific methods in the administration of the modern city is one of the most impressive lessons to be derived from the Budget Exhibit now being held in the city of New York for the information and instruction of its taxpayers. Taking place in October at a time when the annual discussion of the city's appropriations for the ensuing year is in progress, this exhibition supplies a full and illustrated record of the activities of the municipality. Like any large private corporation, a city requires efficiency of management and systematic cost accounting just as if it were concerned with manufacturing or transportation; but on account of political conditions, charter and other legislation, and, even more largely, lack of interest and dense ignorance on the part of the citizen stockholders, municipal efficiency and economy are more difficult of realisation. However, they are the keynotes of all practical municipal administration no less than of the successful conduct of industrial operations, and to the interested taxpayer in such a city as New York they figure prominently at the time of the adoption of the annual budget by the Board of Estimate. To this body must come the heads of all the city departments, with their requests for appropriations for the ensuing year, properly analyzed and classified, and with a record of work accomplished under previous appropriations. To secure the appropriations asked for, the department heads must convince the Board of Estimate and the taxpayers of the city that their estimates are reasonable and the record of their work such as to warrant the desired appropriation, or as much thereof as the best interests of the city will permit.

To get the greatest publicity for these different departmental statements, which in 1910 included the eighteen hundred items that went to make up a $174,000,000 budget, the city of New York for two years past has hired an unoccupied mercantile building on Broadway, where are displayed such charts, diagrams, photographs, and appropriate objects as best illustrate the needs and work of each department, bureau or office. In many cases, such as departments of law and finance, the exhibit is merely statistical or a summary; but in others there are displayed photographs, specimens, apparatus, or machinery which show the application of modern science and engineering to municipal problems and conditions, and the resulting increase in efficiency and economy by the adoption of recent inventions and improved scientific methods. For example, child hygiene, and food and milk inspection are items calling this year for largely increased estimates by the Health Department. At the Budget Exhibit can be seen charts showing what has already been accomplished along these lines together with statements of what is desired. To give point to this there are shown actual photographs contrasting wholesome conditions with those which give rise to disease; also the various physicians, nurses, inspectors and other officials of the department are portrayed at work in schools, tenements, milk stations, and even at the farms. To support the demand of the Fire Commissioner for appropriations for new motor apparatus, there may be seen at the exhibition a high-power gasoline pumping engine, that has recently passed the rigorous requirements of the department engineers, and a modern motor hose wagon temporarily withdrawn from active service. Interesting as these are as engineering novelties, it is in connection with their surprising economy that they find place in the budget exhibit, eliminating as they do the more expensive fire horse, an honored specimen of which is stabled hardby the new apparatus. The best methods of fire-proof construction and fire prevention, soon to be enforced by a new Bureau of Fire Prevention, are also shown.

The Department of Docks and Ferries by plans, photographs and models shows its comprehensive schemes for developing and increasing the water front to provide much needed facilities for commerce. The Department of Water Supply, Gas and Electricity shows the various devices used in the distribution and measurement of water, with some interesting relief maps by which the history of water supply and distribution is shown from the time of the settlement of the city. The progress of the great Catskill Aqueduct is also graphically illustrated by photographs and models, and a comparison is made with previous supply systems.

These few instances are but typical of the many exhibits, both graphic and practical, that make up this most interesting display; but they like others serve to emphasize that close connection between municipal economy and scientific work which is not always realised outside the ranks of municipal engineering. If the lives of the poor and particularly of infants are properly to be safeguarded the testing of milk and food must be done in the laboratory and standards adopted for the inspectors. Improved fire apparatus must be supplied, if adequate protection is to be furnished to buildings that are ever increasing in number, volume and height. New docks for the commerce of the future and to produce revenue for the city must show the best civil engineering of the day. These projects, illustrated and described, do, or should, represent the best engineering of the time. And the citizen who examines the vast budget of the city for its current expenses as well as the bonds issued for permanent improvement, must have the conclusion forced upon him that it is the engineer rather than the politician who should be primarily responsible for conducting the affairs of a great city, at least if efficiency and economy are to be secured. Even under present conditions the part played by the former is greater than many would suspect. It is the engineer, the architect, the sanitarian, the physician, the landscape gardener and other workers of applied science that make our cities. Their influence equals, if it does not surpass that of our legislators and politicians. This fact is impressed strongly upon every understanding visitor to the Budget exhibition.



The "Mayfly" directly after the accident. Only one compartment deflated.

Wreck of the British Naval Airship "Mayfly"

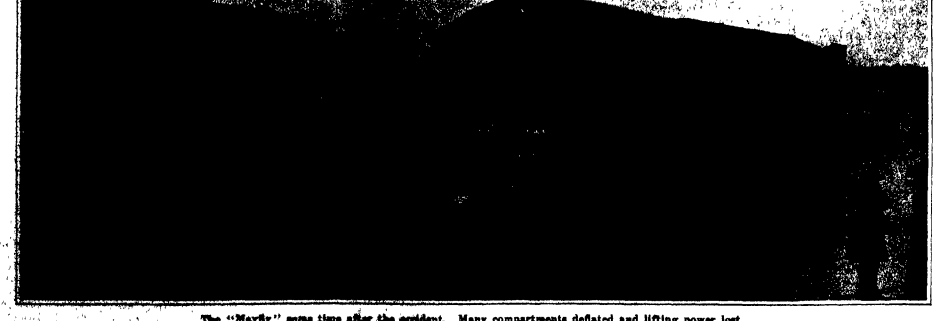
Penalty of Launching a Rigid Dirigible in a Cross Wind

By Carl Dienstbach

RATHER a striking contrast is offered by the pitiful wrecking of the first non-German rigid dirigible, the British naval airship "Mayfly," which broke in two before it even got into the air, and the many excellent performances of Count Zeppelin's new "Schwaben," which at last completely fulfills what the advocates of the rigid system and of the mammoth dirigible so long promised seemingly in vain. When the British ship first came out, it claimed a considerable advance over the Zeppelins, but before its trials could begin in earnest, even its claimed superiority had been far surpassed by the "Schwaben's" actual performances. Its ultimate fate seems to offer a striking object lesson of the fallacy of judging the merits and demerits of a theory from isolated experiences.

It is interesting to try analyzing the causes of this accident from the point of view of the Zeppelin practice. It must be pointed out as a fundamental mistake for an airship to be taken on water from a stationary shed on land in side wind, even though a light one. In 1906 Zeppelin and his engineers had much yet to learn, but even then they were careful to avoid taking the "Zeppelin II." from its stationary shed on the shore of Lake Constance, near Manzell, when the slightest wind was blowing across the entrance. The number of trials that season was much limited on that account, but no exception was made to the rule. It is difficult to hold an airship against lateral wind pressures, and the cars floating on the water and partly submerged cannot yield to a gust as quickly as over land. For this reason the principal Zeppelin sheds on the lake were floating structures, which always swing automatically into the direction of the wind.

Much light is further shed on the naval dirigible's misfortune if we recall that the first frame attempted by its builders was avowedly a complete failure, and that right before the first "coming out" of the ship there had been trouble from the tearing and leaking of the internal gas bags. The first picture of the accident shows the damage all confined to one compartment, and it is reported that the accident originated with the tearing of the gas bag contained in this compartment. The simplest consideration shows how very much the structure of a rigid dirigible is weakened if one compartment near its center should suddenly be deflated. It is a fundamental fact that the solidity of a rigid dirigible results chiefly from aerostatic pressure of the gas in its different compartments. The frame of the first "Zeppelins" partly collapsed over night, when there was no gas in the ship, and some of the ropes by which it was suspended from the ceiling of its shed gave way for some unexplained reason. But if the whole hull represents two halves with gas in each, the case is worse. All the leverage of the lift in these halves is then exerted against the framing of that single compartment, the weight of each car acting as a fulcrum. If there were gas in it, this compartment would not only compensate the strain to a certain extent by its own lift, but furthermore, the pressure of the gas sideways, against the flat ends of the cylinder formed by its gas bag, would most strongly brace it against exactly the kind of strain it encounters. At the point where the strain tries hardest to crush the longitudinal members by compression, namely, along the top, the side pressure of the gas is strongest. One needs but to recall the appearance of an ordinary spherical balloon immediately after inflation. Every rope has then been "frozen" into a rigid bar, and the ordinary rules of architecture are in a way exactly reversed, for everything is pushing up and trying to "flare" toward the top. In a rigid airship the compression strength of the many single members of the frame becomes all powerful if it is aided by this force. Without the gas lift, a member of a rigid frame is strictly "rigid" only for a certain limited distance, as is so well shown in the sad collapse of the naval dirigible's body shown in the second picture, after deflation. Indeed, the frame of a rigid airship should by no means be so weak in itself as to break if a single central compartment should become deflated. The incident on the "Zeppelin III's" trip to Berlin 1909, when the flying blades of a burst propeller pierced the hull, without causing an accident, shows how much resistance it may offer.



The "Mayfly" some time after the accident. Many compartments deflated and lifting power lost.

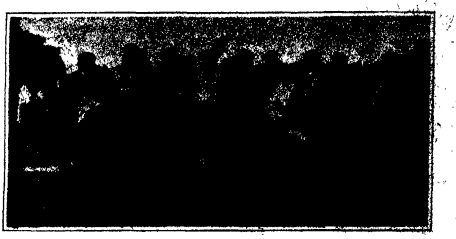
How to Make a Model Aeroplane

A Monoplane Driven by Elastic Rubber Bands Which Will Fly 700 Feet

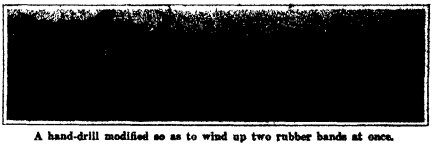
By Cecil Peoli

AFTER the problems of flight had been so far solved that men could take the air with reasonable safety, it was but natural that boys, who like everything that "goes," should take an interest in the flying machine. It is not too much to say that most boys from twelve to eighteen know more about the actual construction of aeroplanes and the difficulties of building and operating them than their grown-up relatives, who stand open-mouthed in the contemplation of spiral dips, figure-of-eight curves, and other antics.

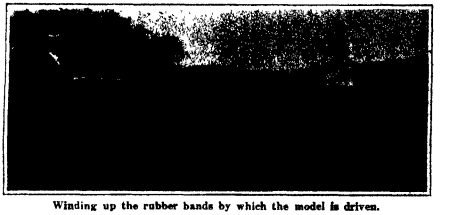
The interest of boys in aeroplanes has led them to build small models of their own. With these, remarkable results are obtained, so remarkable indeed that in the hands of a skillful scientific experimenter, they might be used for the purpose of clearing up some of those mysteries of dynamic flight which are still concealed. Although the results obtained with small models are not always directly transferable to the full-sized machine, there can be no doubt that they will serve the useful purpose of performing at a small expense, in a rough yet sufficiently accurate way, the work which is now being done by costly aerodynamic institutions.



A group of boys at Van Cortlandt Park, all of whom have made their own model aeroplanes.



A hand-drill modified so as to wind up two rubber bands at once.



Winding up the rubber bands by which the model is driven.

Feats Accomplished With Small Models.

The rivalry among boys in the building of safe, stable models is so keen that model-flying contests are held from time to time in various parts of the country, notably at Van Cortlandt Park, New York city. The amount of interest that is aroused is impressive to the man who is unfamiliar with the spread of the model making movement among boys. The feats accomplished by the models are indeed remarkable. One of them, devised by the writer of this article, has flown for a distance of 1,691 feet, driven only by rubber bands. The model which is here illustrated, is built along somewhat similar lines, and will fly for about 700 feet. A boy of an experimental turn of mind can supply it with supporting surfaces of different size and shape, and probably increase its flying range considerably. At all events, the possibilities for experimenting, if the boy who makes this aeroplane is of an inquiring turn, are almost unlimited.

Aeroplane models are sold in stores throughout the country. They undoubtedly fly—some better than others. Their cost ranges from two to five dollars, and upward. The model here shown can be made for much less and will outfly almost any bought model.

The Main Frame.

The main frame of the model monoplane consists of two strips *a* of spruce, each 28 inches long and measuring in cross section ¼ by ⅜ of an inch. As shown in Fig. 1, the two strips *a* are tied together at the front and with strong thread and are then glued, the glue being spread over and between the windings of the thread. (Figs. 1 and 5.) The rear ends of the two strips *a* are spread apart 4½ inches to form a stout triangular frame, and are tied together by cross bars of bamboo *b* and *c*, which are secured to the main strips *a* by strong thread and glue.

The Propellers.

The propellers *d* are two in number and are carried by the two long strips *a*. Each propeller is five inches in diameter, and is whittled out of a single block of white pine. The propellers have a pitch of about ten inches. After the whittling is done they are sand-papered and coated with varnish. The thickness of the wood at the hub (*e'*, Fig. 7) of the propeller should be about ⅜ of an inch. At the rear ends of the strips *a* bearing blocks *e* are secured. These bearing blocks are simply small pieces of wood projecting about ⅝ of an inch laterally from the strips *a*. They are drilled to receive a small metal tube *f'* (steel, brass, or copper), through which tube the propeller shaft *f* passes.

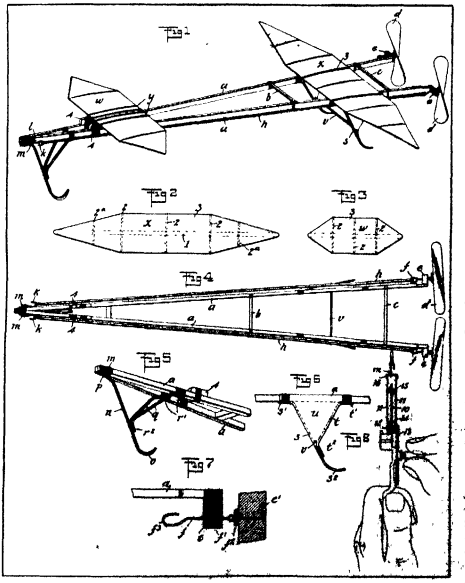
The propeller shaft itself consists of a piece of steel wire passing through the propeller hub and bent over the wood, so that it cannot turn independently of the propeller. Any other expedient for causing the propeller to turn with the shaft may obviously be employed. Small metal washers *f'*, at least three in number, are slipped over the propeller shaft so as to lie between the propeller and the bearing block.

That portion of the propeller shaft which projects forwardly through the bearing block *e* is bent to form a hook *f''*. To the hook *f* rubber strips *h*, by which the propellers are driven, are secured. The rubber strips are nearly as long as the main strips *a*. At their forward ends they are secured to a fastening consisting of a double hook *k l*. The hook *k* lies in a horizontal plane, the hook *l* in a vertical plane. The hook *k* holds the rubber strips, as shown in Figs. 1 and 4, while the hook *l* engages a hook *w*. This hook *w* is easily made by passing a strip of steel wire through the meeting ends of the main strips *a*, the portions projecting from each side of the strips being bent into the hooks *w*.

The Skids.

Three skids are provided, on which the model slides, one at the forward end, and two near the rear end. All are made of bamboo. As shown in Fig. 5, the front skid may be of any length that seems desirable. A 6-inch piece of bamboo will probably answer most requirements. This piece *n* is bent in opposite directions at the ends to form arms *o* and *p*. The arm *o* is secured to the forward ends of the two strips *a* constituting the main frame, by means of thread and glue. The strips and skid are not held together by the same thread, but the skid is attached to the two strips after they have been wound. Hence there are two sets of windings of thread, one for the two strips *a* themselves, and another for the skid and the strips. Strong thread and glue should be used, as before. In order to stiffen the skid, two bamboo struts *q* will be found necessary. These are bent over at the ends to form arms *r'* and *r''* (Fig. 5). Each of the arms *r* is secured to the under side of a strip *a* by strong thread and glue. The arms *r'* are superimposed and tied to the bamboo skid *n* with strong thread and glue.

The two rear skids, of which one is shown in Fig. 6, consist each of two 5-inch strips of bamboo *s*, likewise bent at either end in opposite directions to form arms *s'* and *s''*. The arms *s'* are fastened to the strips *a* by strong thread and glue. To stiffen the skids a strut *t* is provided for each skid. Each strut *t* consists of a 3-inch strip of bamboo bent over so as to form arms *t'* and *t''*. The arm *t'* fits the under side of the main strip *a*, the arm *t''* the skid *s*. Strong thread and glue are employed to fasten each strut in position on the strip *a* and the skid *s*. In the crotch of the triangular space *u*, formed by the skid *s* and the strut *t*, a tie bar *v* (Figs. 4 and 6) is secured by means of thread and glue. This tie bar *v* connects the two skids, as shown in Figs. 1 and 4, and serves to stiffen them. The triangular space *u* is covered with paper, preferably bamboo



Details of the model aeroplane.

paper. If bamboo paper is not available, parchment or very light paper of some kind may be used. It does not need to be waterproof. Thus triangular fins are formed which act as stabilizing surfaces.

The Main Planes.

The main planes are two in number, but are different in size. Contrary to the practice followed in large man-carrying monoplanes, the front supporting surface is comparatively small in area and the rear supporting surface comparatively large. Those supporting surfaces *w* and *x* are shown in detail in Figs. 2 and 3. It has been found that a surface of considerable area is required at the rear of the machine to support it. Hence the discrepancy in size. Although the two supporting surfaces differ in size, they are made in exactly the same manner. Each consists of a thin longitudinal piece of spruce 1, to which cross pieces of bamboo 2 are attached. In the smaller plane (Fig. 3) all the cross pieces 2 are of the same size. In the larger plane (Fig. 2) the outer strips 2a are somewhat shorter than the others. Their length is 3½ inches, whereas the length of the strips 2 is 8¼ inches. In order to allow for the more gradual tapering of the plane, around the outer ends of the longitudinal strips 1 and the ribs 2, a strip of bamboo 3 is tied. The frame, composed of the longitudinal strip 1 and cross strips 2 and 2a, is then covered with bamboo paper, parchment paper, or any other stiff light paper, which is glued in place.

The forward or smaller plane has a spread of 8½ inches and a depth of 3¼ inches. The main plane has a spread of 20 inches and a depth of 3½ inches at the widest portion. The author has made experiments which lead him to believe that the tapering form given to the outer edge of the plane improves both the stability and endurance of the machine.

The planes are slightly arched, although it will be found that flat planes will also give good results. The rear edge of the main plane should be placed 4¼ inches distant from the forward edge of the propeller block *c*.

The front plane must have a slight angle of incidence, just how much depends upon the weight of the machine, the manner in which it is made, and various other factors. This angle of incidence is obtained by resting the front portion of the plane on two small blocks 4 (Figs. 1 and 5) which are fastened to the top of the main strip *a* by strong thread and glue.

The height of the blocks 4 should be about ¼ of an inch, although this will necessarily vary with the machine. The blocks should be placed approximately four inches from the forward end of the machine. The front end of the forward plane should be elevated about one-fourth of an inch above the rear end, which rests directly on the main strips *a*.

Both the front and rear planes *w* and *x* are removably lashed to the frame by means of ordinary rubber bands, which may be obtained at any stationery store. These rubber bands are lettered *y* and *z* in Fig 1

Winding the Rubber Strips.

The rubber strips can be most conveniently wound up by means of an egg beater, slightly changed for the purpose. The beater and the frame in which it is carried are entirely removed, leaving only the main rod 10, which is cut off at the lower end so that the total length is not more than two or three inches The two brass strips 11 on either side of the rod, which are attached to the pinion 12, meshing with the large driving wheel 13, are likewise retained A washer 14 is soldered to the rod near its upper end, so as to limit the motion of the small pinion 12 and the brass strips 11 attached to the pinion Next a wire 15 is bent in the form of a loop, through which loop the central rod passes The ends of the wire are soldered to the side strips 11 Lastly, a piece of wire 16 is bent and soldered to the lower ends of the side strips In order to wind up a rubber strip, the strip is detached from the forward end of the model, and the hook *m* slipped over the wire 16 The opposite end of the rubber band is held in any convenient manner Naturally the two strips must be wound in opposite directions, so that the two propellers will turn in opposite directions By stretching the rubber while it is being wound, more revolutions can be obtained It is not safe to have the propeller revolve more than 700 times The ratio of the gears of the egg-beater winder can be figured out so that the requisite number of twists can be given to the rubber bands for that particular number of revolutions

Instead of an egg beater, a hand drill can be used as shown in one of our photographs This, however will have to be also modified for the purpose, a wire hook being inserted in the jaws In the modified drill here presented, an extra gear has been provided so that the two rubber bands may be wound up at the same time in opposite directions

Rules Governing the Competition for the $15,000 Flying Machine Prize Offered by Mr. Edwin Gould

1. A prize of $15,000 has been offered by Mr. Edwin Gould for the most perfect and practicable heavier-than-air flying machine, designed and demonstrated in this country, and equipped with two or more complete power plants (separate motors and propellers), so connected that any power plant may be operated independently, or that they may be used together.

CONDITIONS OF ENTRY

2. Competitors for the prize must file with the Contest Committee complete drawings and specifications of their machines, in which the arrangement of the engines and propellers is clearly shown, with the mechanism for throwing into or out of gear one or all of the engines and propellers. Such entry should be addressed to the Contest Committee of the GOULD-SCIENTIFIC AMERICAN Prize, 361 Broadway, New York city. Each contestant, in formally entering his machine, must specify its type (monoplane, biplane, helicopter, etc.), give its principal dimensions, the number and sizes of its motors and propellers, its horse-power, fuel-carrying capacity, and the nature of its steering and controlling devices.

3. Entries must be received at the office of the SCIENTIFIC AMERICAN on or before June 1st, 1912. Contests will take place July 4th, 1912, and following days. At least two machines must be entered in the contest or the prize will not be awarded

CONTEST COMMITTEE.

4. The committee will consist of a representative of the SCIENTIFIC AMERICAN, a representative of the Aero Club of America, and the representative of some technical institute. This committee shall pass upon the practicability and efficiency of all the machines entered in competition, and they shall also act as judges in determining which machine has made the best flights and complied with the tests upon which the winning of the prize is conditional The decision of this committee shall be final.

CONDITIONS OF THE TEST

5. Before making a flight each contestant or his agent must prove to the satisfaction of the Contest Committee that he is able to drive each engine and propeller independently of the other or others, and that he is able to couple up all engines and propellers and drive them in unison No machine will be allowed to compete unless it can fulfill these requirements to the satisfaction of the Contest Committee. The prize shall not be awarded unless the competitor can demonstrate that he is able to drive his machine in a continuous flight, over a designated course; and for a period of at least one hour he must run with one of his power plants disconnected; also he must drive his engines during said flight alternately and together. Recording tachometers attached to the motors can probably be used to prove such performance

In the judging of the performances of the various machines, the questions of stability, ease of control and safety will also be taken into consideration by the judges The machine best fulfilling these conditions shall be awarded the prize

6 All heavier-than-air machines of any type whatever—aeroplanes, helicopters, ornithopters, etc.—shall be entitled to compete for the prize, but all machines carrying a balloon or gas-containing envelope for purposes of support are excluded from the competition

7 The flights will be made under reasonable conditions of weather The judges will at their discretion, order the flights to begin at any time they may see fit, provided they consider the weather conditions sufficiently favorable

8. No entry fee will be charged but the contestant must pay for the transportation of his machine to and from the field of trial

9 The place of holding the trial shall be determined by the Contest Committee, and the location of such place of trial shall be announced on or about June 1st, 1912

10 Mr Edwin Gould, Munn & Co. Inc publishers of the SCIENTIFIC AMERICAN, and the judges who will be selected to pass upon machines are not to be held responsible for any accident which may occur in storing or demonstrating the machines on the testing ground

A Weather Forecasting Competition

THE Société Française de Navigation Aérienne has decided to organize a competition in weather forecasting, which will extend over a period of two weeks about the time of the vernal equinox of next year. This season was selected because it is supposed to be characterised by generally unsettled weather, and therefore likly to afford a severe test to the competitors. An elimination contest, the particulars of which have not yet been announced, will precede the principal competition, its object being to shut out the cranks and charlatans who might be disposed to participate in such an event.

The idea of a public contest in weather forecasting is not new. In the autumn of 1905 a competition of this sort was held by the Société Belge d'Astronomie for a prize of 5,000 francs. The competitors were first required to make daily forecasts based on the current weather maps published at the various meteorological centers of Europe; these were submitted by telegraph and registered mail to the jury assembled in Belgium, the members of which were all well-known meteorologists, viz., Messrs. Teisserenc de Bort, Hatch, Pelle, Brunhes, and Vincent. From the twenty-four contestants the seven who submitted the most accurate forecasts were summoned to Liége to take part in a further test. Each of them was required to make a series of forecasts for a twenty-four hour period based upon seven weather maps selected at random from those published by the French meteorological service between the years 1880 and 1902 The jury, having at hand the maps for the days succeeding those selected, was able immediately to verify the accuracy of the predictions

This second test resulted in the further elimination of four competitors, and the remaining three were then required to furnish a statement of their methods of forecasting. The jury unanimously awarded the prize to M. Gabriel Guilbert, of Caen, France, both for his successful forecasts and for his method, which was then first made known to the scientific world, and attracted wide attention.

M. Guilbert has since published a book on weather forecasting.[1]

The Mine-safety Demonstration

A NATIONAL mine-safety demonstration will be held at Pittsburg, Pa., on October 30th and 31st, 1911, under the auspices of the Bureau of Mines. The first day will be devoted to demonstrations at the Bureau of Mines' building in the Arsenal grounds, Fortieth and Butler streets, including exhibits of explosives, safety lamps, fuel testing, etc., and actual explosions. On the same day demonstrations and explosions will be given in the experimental mine near Bruceton, ten miles south of Pittsburg On the second day the demonstrations will be held at Forbes Field the National League baseball grounds This programme will include a first aid exhibit, rescue work and mine gas President Taft will be present and award the prizes, and will afterward be entertained at luncheon at the Hotel Schenley It is expected that the Bureau of Mines will run a special car from Washington to accommodate the officials of the Federal government There is at present prevailing a deep interest in the subject of mine safety appliances and many heads of bureaus and departments will grasp this opportunity of having ocular demonstration of the excellent work being accomplished by the Bureau of Mines Dr Holmes, the Chief of the Bureau, will, of course, be in charge of the demonstrations

[1] Nouvelle méthode de prévision du temps. Paris, 1909.

A Stabilizer for Aeroplanes

A FLYING machine having stabilizing means arranged longitudinally and both in front and rear of the vertical turning center of the machine is shown in a patent, No. 1,001,120, to Joseph A Blondin of Los Angeles, Cal. The stabilizing means include a plurality of members which may be moved laterally to varying degrees which are connected to a movable aviator's seat, thus permitting the convenient operation of the stabilizing members

(Continued from page 331.)

strength plus the reduction of resistance to sliding of the dam upon its undermined base, brought the strength of the dam below the yielding point, and the water burst through. Some broken sections of the wall appear to have been turned completely about their base, others have been pushed bodily downstream upon their base, remaining erect.

There have been altogether too many failures of dams in this country during the past two decades. There is need for State legislative control. Individuals and private corporations should not be left at liberty to build where and how they will. The menace of a badly-designed and ill built dam is so great, that the plans for all structures of this character should be referred to an expert board, appointed by the State, and strongly backed up in all its decisions.

Hail Insurance

THE insurance of growing crops against hail though little practised in the United States, is an old and well-established institution in many parts of Europe. The first hail insurance company was organized in Scotland in the eighteenth century. A large mutual hail insurance company was founded at Brunswick, Germany, in 1791, and another at Neubrandenburg, Germany, in 1797. To-day there are scores of companies in Europe. The greater number of these are conducted on the mutual plan, though there are also many stock companies. In several countries hail insurance companies enjoy a government subsidy, while in one, Bavaria, the government itself insures agriculturists against hail. A similar plan is in operation in the Canadian territory of Alberta, where hail insurance is conducted by the Treasury Department.

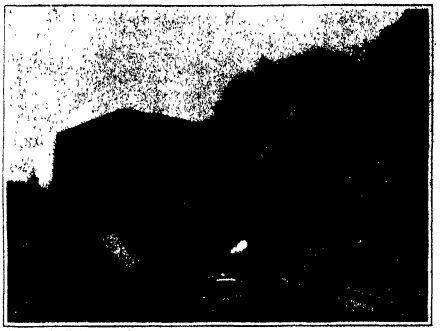
From time immemorial mankind has endeavored to find some physical means of preventing hailstorms. In antiquity the custom of hurling javelins and other missiles against clouds that threatened a discharge of hail was widespread. In the middle ages the aid of the "tempestarii" sorcerer who claimed the power of influencing the weather—was invoked to the same end. Bells, also, were believed to be efficacious in averting hailstorms. Early in the nineteenth century metal tipped poles, called *paragrandines* or *paragreles*, imitated from lightning-rods, were set up in great numbers in many parts of Europe, in the belief that they would draw off the free electricity of the air, which was assumed to be the chief cause of hail storms. About 1896 the custom of "hail-shooting" was introduced in Europe, especially in vine-growing districts, and soon became immensely popular. This consisted in bombarding the clouds with various special forms of cannon. In the year 1900 five hundred of these cannon were in use in France and Spain, 2,000 in Austria-Hungary, and 10,000 in Italy. This custom still flourishes. In Austria and Italy it has been investigated and reported upon unfavorably by scientific commissions, appointed by the respective governments. On the other hand in France and in parts of Russia it has the approval of official or quasi-official authority. It is however open to the fatal objection that even should it prove efficacious, the expense entailed in systematic protection by this method is in excess of the benefits to be obtained. This has been well demonstrated by Baermann for Bavaria and Württemberg, and Hahn for the whole of Germany. Thus, assuming the necessity of installing one cannon per square kilometer, the cost of a complete installation for Bavaria would amount to $7,500,000, and the annual cost of operating would be about $1,750,000.

In the absence of any practical method of actually averting the destructive effects of hail, the agricultural population must look to insurance to mitigate the loss to the individual sufferer. At the present time however hail insurance, although as stated above has been practised for over a century, is founded upon a far from secure basis of information. Statistics of the distribution of hailstorms in space and time, and of the damage inflicted thereby, are systematically collected from year to year in but few countries. For the most part, the companies have been obliged to gather their own information as best they could; and doubtless, in the legitimate desire to protect themselves having regard to the uncertainty of the data available, they have as a rule imposed higher premiums than would be justified if accurate information were at hand. That the aggregate loss due to atmospheric visitations of this class is exceedingly heavy is well known. Thus it is stated that during the year 1907, in the kingdom of Württemberg, a total area of 43,427 hectares—8.7 per cent of the cultivable land of the country—was ravaged by hail, the damage amounting to over $4,750,000. In the last forty years the loss to agriculturists from this cause in the grand duchy of Baden has aggregated $25,000,000. The annual loss for the whole of Germany is estimated at between 70,000,000 and 80,000,000 marks (i. e., from $17,000,000 to $20,000,000). The annual loss in France is about the same. In Italy it amounts to $12,000,000, according to a recent estimate. These enormous losses do not affect the agricultural class alone. In many cases the national revenues are seriously curtailed from this cause, as it is found necessary to remit a portion of the taxes in the regions afflicted.

The first steps toward improving the organization of hail insurance and extending its benefits to all countries have been taken during the past year by the International Institute of Agriculture. At a meeting of the permanent committee of the Institute, November 24th, 1910, the Bureau of Economic and Social Institutions was charged with the task of drawing up a complete report on the present situation of this form of insurance in the several countries. The report, prepared by Dr. Giuseppe Rocca, has now been published,* and is a most useful contribution to a subject the literature of which is at present extremely meager. Dr. Rocca gives statistics of the companies engaged in the business of hail insurance in Germany, Austria, France, Hungary, Italy, and Switzerland; the laws bearing on the subject in those countries, the technique of this class of insurance; and finally a number of suggestions looking to a uniform system of gathering information of damage by hail and to uniform legislation.

This report was submitted to the Institute at its recent general meeting, and recommendations based thereon will be transmitted to the several governments.

As the recommendations of the Institute will probably lead to the organization of hail insurance companies in this country it may interest some of our readers to know that a number of books has been published in Germany for the guidance of persons engaged in the task of assessing the damage due to hail. A list of them will be found at the end of the article "Hagelversicherung" in Meyers Grosses Konversations-Lexikon, sixth edition.



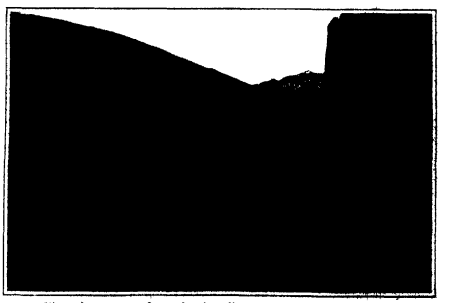
Copyright by Underwood & Underwood 1911.

Houses were swept before the flood like cardboard.



Copyright by Underwood & Underwood 1911.

Looking downstream through gap in the wall of dam.



View along upper face, showing displacement of broken masses.

THE FAILURE OF THE AUSTIN DAM

The Colors of the Earth

THE two great elements of difference in the same landscape in winter and summer are, of course, the presence of snow in winter and of leaves and grass in summer. If we could look at our globe from the moon the variation in its aspect due to seasonal changes would perhaps be even more striking than it appears to those on the surface.

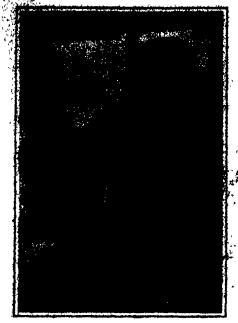
In fact, we sometimes lose sight of the very important part which vegetation plays in giving color to what might be termed the countenance of the planet.

It is not the higher forms of plants that always produce the greatest effect in this way. Some of the most striking scenes upon the earth owe their characteristic features to mosses and lichens. The famous "crimson cliffs" of Greenland which extend for miles northward from Cape York, derive their splendid color from the growth of red lichen that covers their faces.

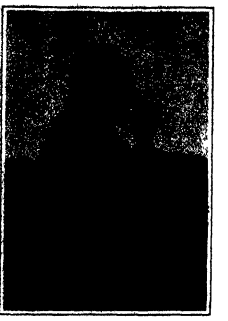
The cliffs rise between seventeen hundred and two thousand feet straight from the water's edge, and being composed of gray granite, their aspect would be entirely different from what it is but for the presence of the lichen.

The rocky pass called the Golden Gate in the Yellowstone National Park owes its rich color and its name to the yellow lichen covering its lofty walls; and the indescribable hues of the great hot-spring terraces arise mainly from the presence of minute plants flourishing in the water that overflows them. Considered as a whole, the vegetation of a planet may give it a characteristic aspect as viewed from space. That its broad expanse of forest and prairie land causes the earth to reflect a considerable quantity of green light to its neighbors is indicated by the fact that at the time of the new moon a greenish tint has been detected overspreading that part of the lunar surface which is then illuminated only by light from the earth.

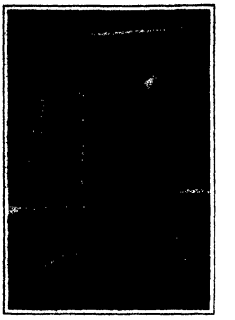
* "Les assurances privées contre grêle, en cas de mortalité du bétail et contre la mortalité parmi les animaux transmissibles." Bureau des Institutions Économiques et Sociales, Institut International d'Agriculture. 1911. Pp. 1, 198.



Glenn H. Curtiss, winner of the Scientific American trophy, first to rise from water in a biplane.



Louis Blériot, France's premier monoplane inventer, first to cross the English Channel, July 25th, 1909.



Wilbur Wright, the elder of the two brothers who built the first practical aeroplane.



Morane, the former Blériot pilot, who has invented an exceedingly fast and efficient monoplane.

The Business Side of Aviation

The Money in Flights and Machines

IT SEEMS at first glance somewhat premature to rank the new art of flying among the accepted and recognised branches of industry; but on close examination of the actual state of aviation affairs at present there is found ample reason for doing so.

In the past three years an astonishingly large field of commercial and business activity has been built up, that has to do solely with aeronautics.

There are few who have stopped to realise the suggestive fact that more than half a million men are now actively engaged in some industrial enterprise that has to do with navigation of the air.

To fully appreciate the significance of the commercial side of aviation, a knowledge, or at least an acquaintance, must be had with demands on a flying machine, its uses and the commodities whose manufacture, sale or exchange constitute "the trade."

Aeroplanes at present are used in three distinct ways—for sport or convenience, in war or postal service, and as a means of profit in exhibitions, etc.

The use of the aeroplane by sportsmen and its use by individuals or corporations as a convenience, is the field best developed at present, and for which the greatest future is predicted.

The use of aeroplanes in war seems already definitely assured.

Exhibition flying, however, is likely, and in fact has begun to decline, although races if sufficiently exciting are likely to persist.

A great impetus to the use of aeroplanes by sportsmen is bound to come soon, with the further perfecting of the hydro-aeroplane

The Trade.

The market for aeroplanes is of considerable magnitude, as indicated by the volume of sales made by the various companies. M. Blériot has sold several hundred aeroplanes since the spring of 1909, when he first began manufacturing them on a large scale He has almost been outdone by the Voisins and Henri Farman, while the enterprise of Esnault-Pelterie, Sommer, Breguet, Nieuport, and a score of other constructors in France brings the total of actual sales to a surprisingly large figure.

A single-seater Blériot monoplane costs $4,000 francs, and a two-seater, 28,000 francs This is also the price of Voisin biplanes. A Breguet biplane costs about $6,000 and an Antoinette monoplane is even more expensive.

In general, the range of prices in France is from 15,000 to 30,000 francs.

In England the cost of "all-British" machines like the Valkyrie and Howard Wright runs from $1,500 upward, the price of English made machines being much lower than for those of foreign make

In the United States there are not over a dozen large and established manufacturing firms, with the Wright, Curtiss and Burgess companies as recognized leaders. The Burgess Co has sold more than thirty machines, the Wright Co. two or three times as many, and the Curtiss firm also a considerable number The average price of American machines is $5,000, although the Burgess Co charges $7,500 for a biplane of the Wright type equipped with a Gnome motor. The sales here are at present much less than abroad

It may be conservatively estimated that the sales of aeroplanes to date, both here and abroad, amounts to about 1,500 Placing the average price paid for these machines at $5,000, it becomes evident that the volume of business is represented by an outlay of well over $7,000,000.

In England, for example, the import trade from January to August, 1911, is represented by $177,000, and the export trade by $70,000, thus giving an insight into the magnitude of the trade between England and foreign countries The exports of France and the imports of America are greater, all statistics proving that France leads the world in the aeroplane industry

The Blériot factory employs about 600 men, and is replete with the most up-to-date facilities The Wright Company has an equally efficient plant of modern buildings, shops and assembly rooms In fact the growth of most aeroplane factories has been phenomenal, and yet the real lasting market for the aeroplane has been but slightly reached

Greater even than the trade in aeroplaning, as a unit, has been the activity in the supply and demand for aeroplane accessories from motors and propellers to the minutest parts of metal or wood

There are fifty or more established firms in this country alone, doing a large business in parts of aeroplanes, like ribs, struts, joints, etc As in France, propellers are being designed and manufactured by more than ten firms devoted to this alone

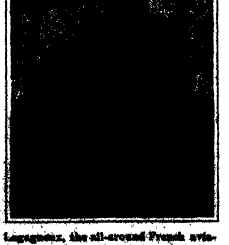
In France the Chauviere Company is a large corporation employing many hundred men, with extensive shops, and turning out countless propellers for all types of aircraft

Many of these separately manufactured parts never get to be used in a full fledged aeroplane, but serve merely for purposes of experiment

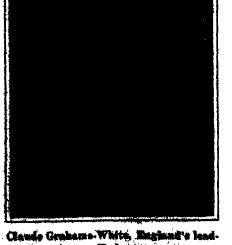
The motor trade is also large, especially in France The Gnome company pays dividends that few "industrials" ever reach, and its business grows apace Many American motors are showing excellent qualities and are much preferred here to the higher priced foreign motors

Aeroplane supply houses abroad have ceased to be

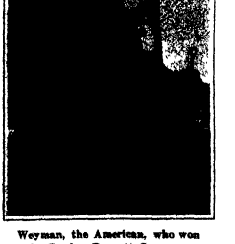
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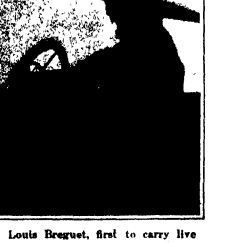
Legagneux, the all-around French aviator, who has made records with both monoplanes and biplanes.



Claude Grahame-White, England's leading aviator. He has won many cash prizes.



Weyman, the American, who won the Gordon Bennett Cup race this year in England.



Louis Breguet, first to carry live load equaling weight of machine.



Fig. 1.—This designer was haunted by the fear of edgewise tumbling. He did not know that drums are inefficient lifting surfaces.



Fig. 2.—A marquis's idea of applying the principle of centripetal stresses. Too much head resistance here.

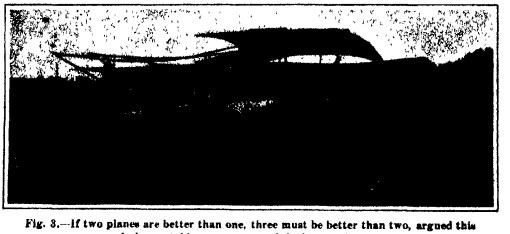


Fig. 3.—If two planes are better than one, three must be better than two, argued this designer, taking no account of the head resistance.

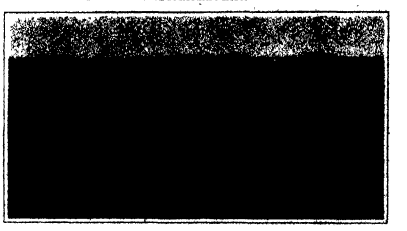


Fig. 4.—Here the eye rests in peace, for compared with standard designs the variations are more conspicuous than radical.

MIDSUMMER MADNESS IN AEROPLANE DESIGNS

A Chamber of Horrors

Wild Designs in Flying Machines

By Marius C. Krarup

EVERY one of the aviation machines shown in the accompanying illustrations is dear to its maker or designer and to his friends Every one of them has something in its construction which is promising, sensible or brilliant to men whose ability in the ordinary walks of life has been sufficient to enable them to save or borrow the money wherewith to substantiate their faith in aviation All but one are proudly photographed, ready to fly at the word "go" Yet only the one not so pictured ever made a start The others probably still cherish the convictions which created them by means of occult or theoretical qualities, the nature of which the uninitiated beholder may only surmise Here is a problem for the psychologist to solve Mechanics alone scarcely furnish the key to its correct solution The shrewd observation that it is better to get into the "game of aviation" wrong than not to get into it at all in its beginning may have shaped many of the hasty creations which abound in the shops of amateur aviators the world over They are evidence of a widespread desire to become identified at almost any cost with a movement clearly destined to be more conspicuously picturesque in its unfolding than any other which civilization has ever witnessed, and prodigiously fruitful in physical, scientific and financial adventure. These odd structures are claims staked off on the hills of golden promise, and the cheerful prospectors confidently expect to "grow up with the country," and to reap the rewards which come to all sturdy pioneers A single unproportioned thought, "given his art" contrary to the advice of Polonius and embodied in steel, wood and fabric, is boldly offered as the entry fee, and lo! the world generously accepts it For is it not after all proof of courage and energy, those primary traits of character which are as much needed for progress as mere insight, which grows with what it feeds upon and may be acquired These men shall have free passes to glory and advancement provided they stand by their claims, work them and guide their next steps a little more closely to the sum total of dry facts and experiences from which real flying aeroplanes have been evolved.

The unproportioned thoughts manifested in the various machines are not without interest The edgewise tumble has haunted the maker of No 1. Of this he is sure So long as the motor and propeller are kept working, these drums will uphold whatever they are capable of upholding, whether the wind tosses them to one side or the other Pivoted as they are to the elegant trussed frame, they afford means for sustentation, for steering and for fore-and-aft balancing, all combined in a single mechanical conception. If the propellers cease propelling, simply tilt both drums forward for a gradual descent Should the impact with the earth be a little hard, the structure offers the same advantage which has served Latham so well in his Antoinette flier, namely, that there is much material to be broken before the shock reaches the aviator's person. It seems almost a pity that the laws of the atmosphere will not permit drums to act as efficient aeroplane lifters

The machine shown in Fig. 2 is the contribution of the Marquis d'Equevilley. It may be imagined that the scion of a noble house has started his train of thought with a profound respect for the magic strength of a bicycle wheel By developing its great principle of centripetal stresses it should be possible to produce a very light framework rich in capacity for areas, strong and yet deformable at its ovalized periphery, and, Eureka! with motor and aviator centrally located and applying the vital forces of propulsion and control from the rigid hub, the very deformation of the rim and planes might be utilized for steering and balancing. Note also the forethought evinced in shaping the upper planes with a self-righting curvature.

If two planes are better than one, then three planes are better than two. This is the simple and powerful idea embodied in the apparatus pictured in Fig. 3, and which is known as the Bousson-Bourgnis. It is common to many triplanes. In addition, an abundance of rudders, generous in size, and a certain flabby flexibility in all the areas, testify to an active, energetic misunderstanding of nearly all the leading principles in successful aviation. The head-on resistance is enormous. What might perhaps have been gained by using perfectly elastic materials shaped and proportioned so as to return an equivalent in work for the power expended in bending the planes back, is squandered through the acceptance instead of unresponsive materials, endowed with an inert flexibility rather than resiliency, the bending of which, under the influence of air resistance, means mainly the generation of heat from molecular friction and the consequent wasting of the power employed for overcoming the air resistance

Stoeckel's monoplane (Fig 6 in this series) was expected to work a revolution in aeroplane dynamics, for it is equipped with a motor of only twelve horsepower driving two propellers of very modest diameters located far below the level of the planes and the bulk of the air resistance. Under these circumstances the machine should immediately tip over backward the moment the wheels leave the ground, but the designer has placed an inverted canoe, also useful as a sunshade, lengthwise over the central portion of his machine, and in this device he must have anticipated special virtues, not only the feeble merits of an underaired parachute, but something extraordinary in the way of balancing effect, since it is otherwise an axiom among aeroplane builders that the power and the air resistance must be kept pretty well in line. As a wind wagon skipping nimbly over the aviation field the compact Stoeckel, with its short wheelbase, should have real merit, however, not to be equaled for meets, particularly if the inverted canoe, as the illustration suggests, may be tipped and utilized to preserve the balance.

The largest aeroplane in the world is shown in Fig. 5. It was constructed at Dunstall, near Wolverhampton, by Lieut. Seddon of the British navy. It is equipped with two 80 horse-power engines and its planes measure an area of 1,600 square feet. The boldness of the figure and of the mechanical execution, with the great loops and sweeping curves suggesting the expert in Spencerian handwriting, almost disarms criticism, punishing it with the query: Can this be possible? Can this be what we are striving for and

what we are coming to! In that case, would it not be better to leave aviation alone until a more advanced mastery of materials shall have made it possible to accomplish it by simpler designs? The large hoops, covered with ribbed like them and tied at the crossings, give great freedom in restoring any desired relation between the planes. By mere changes in the angles and the points of contact of the hoops, practically the same framework may be utilized for a number of experimental variations, and perhaps it may be assumed that the designer has been actuated by this consideration, knowing that the tandem arrangement of planes has been found unfavorable to equilibrium, but knowing also that no large aeroplane construction can be expected until this difficulty shall have been experimentally overcome. But the design looks more theoretical than inspired.

The engineer responsible for the example in Fig. 7 has also tackled elongated construction, being plainly actuated by hopes of escaping from the problem of lateral equilibrium. As for the necessary sustentation, there this scow being sucked forward through the atmosphere at great speed by the innocent little propeller, and the friendly mind will readily perceive how the bow will throw powerful air waves upward against the flying-fox membrane extending from the gunwale, fairly lifting the structure; and, moreover, the hollow of the scow will create a vacuum—the vacuum being a highly favored phenomenon among independent aeroplane designers, nearly always produced without special expenditure of power—to fill which a mighty upward pressure from the atmosphere underneath will automatically assert itself. The hand wheel in front of the operator seems to connect with a simple rudder at the top for side steering, and the perfect lateral balance produced by the narrow conformation and the low center of gravity (really permissible with this shape) should render all other and auxiliary steering means superfluous. For up-and-down steering perhaps the aviator slides his own weight forward and backward.

The seven machines mentioned and illustrated in the foregoing might have been proposed and built whether Lilienthal, Maxim, Langley, the Wrights and Blériot had ever gathered data for aviation or not. But on the Dlapason monoplane (Fig. 4) the eye may rest in peace. As compared with standard design, its variations are more conspicuous than radical. The tail and side-steering apparatus have been cut in twain and moved to the two sides; the *ailerons* have been moved rearward. The arrangement makes room for a large propeller, and, while the equilibrium seems more sensitive, the means for maintaining it and for steering may at the same time have been improved. The machine is said to have flown with some success, and it would be rash to assert its superiority or inferiority in comparison with other models depending on control by rudder action. It accentuates this feature, making even stronger demands upon the aviator's agility than the standard type.

Recent Aeroplane Accidents

DURING the past month there have been many accidents. In several of these the aeroplane has caught fire in the air, and the aviator has been burned to death or killed by the fall. One such accident occurred in France on September 2nd, another in Spain two days later, and the third, in which two men were killed, happened in Germany on the 7th ult. Maron, the French pilot of the Savary biplane, was the first victim of this type of accident. He experienced a bad fall on the 2nd ult. His machine caught fire, and when it struck the ground, he was incinerated under the débris. Lieut. de Grailly, of the French army, also fell and was burned to death on the 2nd inst., owing, it is claimed, to the breaking of a wing of his R. E. P. monoplane. Capt. Camine, with the same make of machine, was killed by the fall due to the same cause. On September 5th, M. Leforestier, a French aviator, fell to his death at Huelva, Spain. His machine, which was of his own construction, is said to have caught fire in the air.

Two other men who were victims of this kind of accident were Lieut. Newmann, a German military aviator, and M. Leconte, his passenger. While making a cross-country flight on September 7th the machine caught fire when at a height of sixty feet, and fell to the ground, instantly killing both aviators. The same day, Paul Senge, another German aviator, fell and fractured his skull at the town of Karlsruhe.

Two days later Herr Eyring was killed near Stuttgart. On September 29th, Capt. Englehardt, Germany's premier military pilot and the first man whom the Wrights taught to fly in that country, was killed by a fall, while his passenger, Herr Sedlmayer, had his skull fractured and received other serious injuries.

In England, Lieut. Cammell, a seasoned Blériot pilot, on the 18th ult., fell to his death while making his first flight in a Valkyrie (English) monoplane. He had been aloft 10 minutes and was making his second wide circuit when the monoplane turned over and dropped 90 feet to the ground. Capt. J. J. Frisble, Louis Rosenbaum and Cromwell Dixon were killed in America when flying at State fairs. The last-named aviator, a youth of but 19, fell 80 feet into a stone quarry at Spokane, Wash., on October 2nd, owing to his turning too sharply to avoid hitting some telegraph wires, and sliding down on end as a consequence. A few days before at Helena, Mont., Dixon had flown over the Rocky Mountains to Blossburg, a small town 18 miles away, and back again. Blossburg lies in a deep pocket in the mountains, from which wild ducks and geese escape with difficulty after battling with the air currents sometimes for hours. It took Dixon twice as long—22 minutes—to attain the necessary altitude of 7,000 feet at Blossburg as it did at Helena. The trip out and back across the 6,200-foot Mullins Pass was made in 15 and 17 minutes respectively. Dixon was given a $10,000 purse made up by several men who witnessed his flight. He delivered a letter from Governor Norris. This is the second time a Curtiss biplane has crossed the Rockies. Ely was the first to accomplish this feat at Butte, Mont., last spring.

On September 25th, at the Nassau Boulevard meet, Dr. Clark, a trick bicyclist, had a fatal fall in a Queen monoplane. He was unable to accustom himself to moving the warping control lever outward instead of inward when turning. A sharp turn to the right, caused by improper warping, resulted in the instant development of gyroscopic force by the revolving motor sufficient to make the machine dive vertically to the ground.

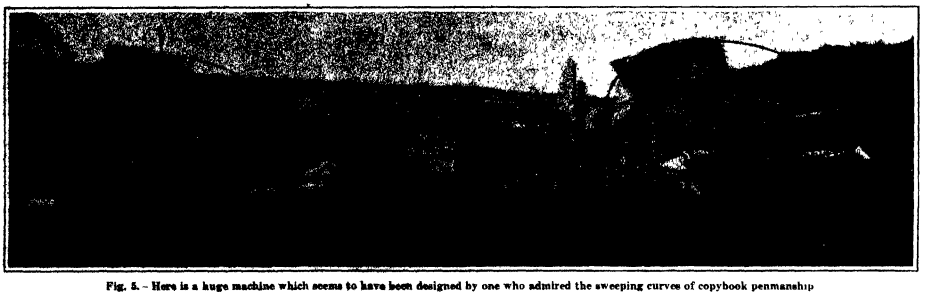


Fig. 5.—Here is a huge machine which seems to have been designed by one who admired the sweeping curves of copybook penmanship.



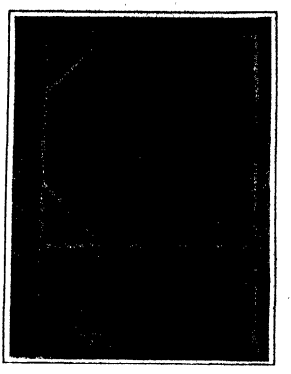
Fig. 6.—A monoplane that was invented to "revolutionize" aeronautics and didn't.



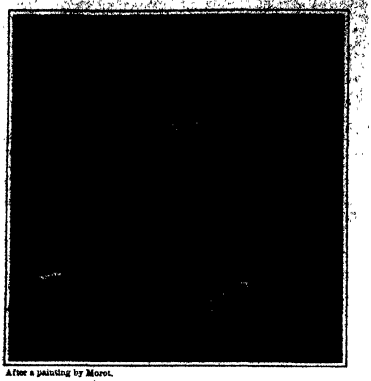
Fig. 7.—Fancy this scow being sucked forward through the atmosphere at great speed by the innocent little propeller!



Prof. L. Prandtl of Goettingen.



A view of Eiffel's wind tunnel.



After a painting by Moret.

Gustave Eiffel.

Progress in Aerodynamics

Studying the Aeroplane in the Laboratory

By Grover Cleveland Loening, Author of "Monoplanes and Biplanes"

IT is the precise methods of engineering that will eventually place flying on a successfully commercial basis As in all other branches of engineering, the theorists and the physicists point the way and give the methods that lead the practical man to the definite solution of perplexing problems, and in this aviation differs in no respect from any other art or science

The determination of the fundamental characteristics of air flow and air pressure on different kinds of surfaces and forms has led without doubt to a quicker and surer success in actual aeroplane flight, but it is qualitative rather than quantitative results that have been obtained so far

Up to the present few if any experiments in measuring the actual values of pressures on surfaces have been conducted on full-sized aeroplanes The results that have been obtained come chiefly from extensive indoor laboratory experiments conducted on planes and shapes of small size, often only one-thousandth of the size of planes used on successful machines

But these small-scale experiments have in most cases been performed with great care and refinement, and from their results there are established the following empirical and fundamentally important laws and equations

A. Any air pressure on any plane or shape varies within the range of speed used in flight, substantially as the square of the velocity, and directly as the size of the surface For the simplest case, a flat plane placed normal to the air stream, the air pressure P may be expressed as

$$P = K\,S\,V^2$$

where S = the surface area, V = the velocity of the moving air against the fixed surface or conversely of the moving surface against the still air, and K = a numerical constant, the most probable value of which is 0 003, when S is expressed in square feet and V in miles per hour

This is an empirical relation, derived from the results of many experiments, and upon it is based practically all of the theory of aerodynamics that finds application in actual practice

B Air passing a surface, or conversely a surface moving through air, causes a frictional drag on the surface, which varies almost as the square of the velocity and directly as the length of the surface

Many formulæ have been proposed, some based on experimental data and some on theoretical conclusions, but they differ widely from one another, and the value of this "skin friction" is still a subject of controversy, many experts claiming that friction is negligible, many others that it is of considerable value Here is a branch of aerodynamics still open to investigation, although the excellent results of Prof. Zahm seem almost conclusive evidence of the large value of frictional resistance.

C The pressure on an inclined flat plane varies with the angle of inclination to the air stream, but bears a fixed relation to the pressure on the same plane, when placed normal to the air stream If we let P = normal pressure, and P^1 = pressure acting on a plane when it is inclined below normal, at an angle a above the horizontal, then we may express this fixed relation between P and P^1 as

$$P^1 = P\,\frac{2\sin a}{1+\sin^2 a}$$

This is known as Duchemin's formula, and has been verified again and again by actual laboratory experiments on small flat planes. A very simple approximate relation suggested by Eiffel is

$$P^1 = P - \frac{a}{30}$$

The normal pressure P may be determined for any plane at any velocity by the relation of $P = KSV^2$, this pressure being gradually reduced as the plane is inclined to a value P^1, corresponding to that angle of inclination.

D. The pressure on arched planes is much greater than on flat planes, and may be equated to the value of the pressure on a flat plane of larger area Whereas in inclined flat planes the pressure P^1 is always perpendicular to the plane, on inclined curved planes at low angles P^1 is inclined in front of the perpendicular to the chord of the plane.

Unlike flat planes, the pressures on curved planes cannot be reduced to intelligible formulæ, and therefore in order to determine the pressures on curved inclined planes, resort must be had to tables of air pressures obtained from actual measurements on test surfaces and not to any formulæ based on such measurements The pressure P^1 on curved planes is usually tabulated as some percentage of the normal pressure P. It is in the determination of the pressures on curved surfaces that the results of aerodynamical experiments on small surfaces have been of most use in aeroplane designing. Lilienthal, Wright, Prandtl, Eiffel, Maxim and Stanton have all made determinations for curved planes that have found much practical application.

E. On curved planes, as well as on flat planes, the total pressure P^1 acting on the plane when the latter is inclined at an angle a, may be resolved into a vertical component L and a horizontal component D. The component L is called the "lift," and is equal to the weight of the aeroplane, while D is called the "drift," and is the dynamic resistance to motion overcome by the thrust of the propeller.

F. On curved planes, as the depth or amount of curvature or arching is increased, the drift resistance increases In other words, flatter planes have less resistance than more highly arched ones. The experimental results of Prof. Prandtl of Göttingen are particularly definite on this point.

G On curved planes, as the aspect ratio or ratio of span of plane to chord is increased, the lift increases greatly for the same area. Both Eiffel and Prandtl have amply verified this.

H. Experiments show that on a plane there exists a point at which all the pressures on the plane may be considered as concentrated without disturbing the equilibrium. This center of action of the forces is called the "center of pressure." On flat planes the center of pressure moves steadily forward from the center of the plane to a point near the front edge as the plane is inclined from the normal or 90-degree position to 0 degree. On curved planes a totally different action is observed. The center of pressure moves steadily forward from the center of figure to a point about one-third the width of plane from the front edge, as the inclination is reduced from 90 degrees to 15 degrees, but at this point it turns abruptly and moves rapidly to the rear, passing the center of figure at about 5 degrees.

I. Experiments in aerodynamic laboratories have further enabled forms of least resistance to motion to be determined and show what kind of torpedo or fusiform



Apparatus recently used in France for testing large surfaces in the open air.

shows give the least disturbance of the air streams.

K. In addition, experiments on propellers have added immensely to the knowledge on this branch of aerodynamics, and have enabled air propellers to be designed that give a higher efficiency than is obtained in marine practice. The great French propeller manufacturing companies have had elaborate experiments conducted on full-size propellers, and have used the results to great advantage.

L. The experimental photographing of the action of air streams on different planes and shapes has been a valuable contribution to aerodynamics and holds promise of becoming a field of much larger scope within a few years.

These are fundamental "quantitative" results.

In many cases the values of different experimenters for the same thing show wide variations. In determinations of the constant *K*, for example, various values from 0.003 to 0.004 are obtained, and many other differences are found. The "quantitative" results of experiments in aerodynamics are as yet not fixed, and it must be conceded that until reliable numerical values are obtained the precise engineering design that is looked forward to is hardly possible, even though excellent approximations may be made.

The chief sources of error or difference in the experiments conducted thus far appear to be in the method and size of planes used. Whether size of surfaces has any effect on the nature of the pressures or their unit values is a problem in aerodynamics that is still to be solved. Many claim that the majority of experiments have been conducted on such small test surfaces that their results are of little value. Like all other aerodynamical problems, the answer is to be found in experiment only.

There are five different methods of conducting experiments on test surfaces or models. These are:

1. Dropping the surface from a height in open air or in a closed room. M. Eiffel conducted a series of experiments on the Eiffel Tower in 1905, in which he allowed the test surfaces to fall about 300 feet. Lilienthal made some use of this method in the open air, and at the Russian Aerodynamic Institute of Koutschino, built by M. Riabouchinsky of Moscow, it has been employed.

2. Attaching the surface to a carriage moved on rails, as done by Prof. Prandtl at Frankfort, or sliding down a long inclined railway, as performed by M. Canovetti in Italy.

3. Mounting the surface and testing apparatus on an automobile and driving at high speeds, taking careful record of the pressures. This method was employed to great advantage by M. Eanault-Pelterie some years ago in France.

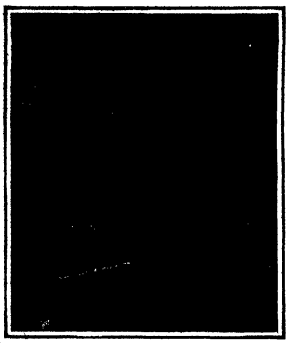
4. By means of a "whirling table" or large rotating arm, at the outer end of which are carried the forms and planes to be tested. The first aerodynamic testing apparatus, the old 8-foot whirling arm of Rouse used in 1758, was of this type. Later Langley, Maxim, Renard and Lilienthal used it to determine pressures on planes, and to test propellers. The huge new Vickers-Maxim testing table is the latest device of this kind.

5. By a wind tunnel. There are three main kinds of wind tunnels. In the first, used by Eiffel, Prandtl and Maxim, a huge fan blows air into a restricted passageway, and the air is then conducted through various screens and chambers until it issues out past the test surfaces in a more or less uniform steady current. At Göttingen the elaborate character of the air passageway and screens renders the air stream practically perfect in its evenness of flow as it passes the test planes. In the second type of wind tunnel the air is drawn in past the test surfaces by a powerful fan placed in back of them. This is designed to avoid the "churned" air that is exhausted from a fan or propeller. Dr. Stanton in England and Prof. Zahm in this country use wind tunnels of this type. The third type consists of a fan blowing air through a chamber and screens as before, but at the end of the chamber is a nozzle which contracts the air stream and greatly increases its velocity. M. Ratsun has used a wind tunnel of this type in his laboratory in Paris.

The actual devices for measuring the pressure vary greatly with the different experimenters, and this plays, no doubt, an important part in the variations observed in their results. Pressure gages, often inclosures, hydraulic apparatus, aerodynamic balances of great sensitiveness, pendulum devices capable of easy exact calibration, graphical records on cylinders for movable pointers, electrical contact devices and comparison systems with standard flat planes, are some of the many means employed.

To measure the actual velocity of the air stream, anemometers are used, and are either of the rotary cup type, recording on dials, or of the pressure type, in which the pressure of a surface acts through a spring and operates a large pointer.

Only recently the great differences between conditions of air pressure and air flow inside a room and out in the open air have been recognized. The air in a closed room is perfectly quiet and lacks the characteristics of turbulent motion of the open air, characteristics that very likely have much to do with pressures on a surface of an aeroplane. Although a simple means of determining air pressures, the wind tunnel resembles only slightly actual free flight conditions, and many of the results obtained by this method of experiment are seriously open to question.



Eiffel's laboratory. General view of the blower opening in front of which the test planes are mounted.



Scale model of the Nieuport monoplane, experimented with by Eiffel.

Whirling arms, if small, or if rotated at too high a velocity, cause the air about them to assume a rotation, and thus render the results of the experiments inexact.

Movement in a straight line in the open air is now recognized as the best means of experiment in aerodynamics, and the one that holds the greatest promise of establishing fully and exactly the great laws of flight.

The next step forward after experiments with small test surfaces has already been taken. M. Eiffel, for the past few months, in his splendidly equipped laboratory at the Champ de Mars, Paris, has been making determinations on reduced reproductions of actual aeroplane types, models equipped with propellers, motors, wheels and all. These experiments, despite their small scale, are the most valuable conducted so far, and have enabled M. Eiffel to lay down many more fundamental laws that have a direct and important bearing on aeroplane work.

One of the most interesting facts he has brought out is that when two identical planes are superimposed as on a biplane, the lift per unit of surface is less than if the same surface is used as a monoplane. These significant results show that as the distance between the planes is increased from 2/3 to 3/3 and to 4/3 of the depth, the corresponding reduction of unit pressure due to placing the two planes one over the other is 85 per cent, 70 per cent and 75 per cent.

M. Eiffel made extensive measurements on model wings of eighteen different aeroplane types, and made especially complete measurements on models of the new R. E. P. and the Nieuport monoplanes. His investigations on the distribution of pressure over a plane show definitely that the pressure at the front edge is very high, much higher than most aeroplane constructors suppose, and that at the rear it is very low, having often a negative value, i. e., the air is pressing on the upper face of the plane instead of the lower face.

Flight is being rapidly advanced and made safe by the instructive experiments of searchers in this new and fascinating science of aerodynamics.

The Moon and the Clouds

IN *Symons's Meteorological Magazine*, July, 1911, Mr William Ellis, F.R.S., discusses the widespread belief that the full moon possesses the faculty of clearing away clouds. This belief, which is expressed in the French proverb, "La lune mange les nuages" ("The moon eats the clouds") was held by Sir John Herschel, Humboldt, and Arago, but it has no foundation in fact.

Many years ago Mr. Ellis tested the question by examining the observations of the amount of cloud made every two hours at the Royal Observatory, Greenwich. Grouping together, during the period discussed, the observations on the five days about full moon, and similarly the five days about new moon, there was found in both cases to be, on the average, a *maximum amount of cloud* in the forenoon, and a minimum amount in the evening. Now, if from any cause there was found to be a greater dispersion of evening cloud under a full moon than at the time of new moon, the evening amount of cloud at full moon should be considerably less than that at new moon, but there was no significant difference, the amount at the time of full moon being slightly greater than at new moon, this giving no support to the supposition of lunar influence to disperse evening cloud.

The same result was arrived at a few years ago, but by a different method, by Rev. S. J. Johnson. He noted the state of the sky at moonrise and at midnight on the day of full moon for fifteen years. Of 186 occasions of full moon, in 126 there was a similar sky when the moon rose and at midnight, in 33 the sky was clearer about midnight than at moonrise, and in 27 the sky was more overcast about midnight, hence he found nothing to support the belief referred to.

The belief is easily explained. There is, on an average, a progressive diminution of cloudiness toward evening—quite regardless of the moon's phase. The physical explanation of this phenomenon need not be given here. It was set forth a few years ago by Dr. W. N. Shaw, in the *Quarterly Journal* of the Royal Meteorological Society. Now, the change from a cloudy to a clear state of the sky is much more likely to be noticed when occurring near full moon, for with no moon the disappearance of the clouds, though making the stars visible, does little to change the general aspect of the evening, while under a full moon the disappearance of the evening cloud changes the whole appearance of nature, and attracts the attention of the most casual observer.

Brightness of the Rising and Setting Sun

CAMILLE FLAMMARION undertakes to answer, in *L'Astronomie*, the following question, proposed to him by a correspondent: Why are our eyes less dazzled by the sun toward sunset than just after sunrise? Is the early morning sun really brighter than the late afternoon sun?

There are two answers; one physiological, the other physical. The retina becomes progressively more sensitive in the dark. A sudden illumination at night dazzles our eyes, whereas the same absolute intensity of light would have much less effect in the daytime. During the day the eye becomes gradually more and more accustomed to the light; in other words, less sensitive to it.

However, the setting sun is probably actually less bright than the rising sun, because of the diminished purity of the atmosphere through which it shines. Solar radiation pumps up an enormous amount of moisture from the earth during the day.

Abstracts from Current Periodicals

Phases of Science as Other Editors See Them

Open-tube Telescopes

IN an article published in the *American Journal of Science* Mr David Todd discusses certain points in the construction of telescopes and suggests a plan for the building of an open-tube telescope presenting a number of novel interesting features

All telescopes are made up of three parts Object glass, eye piece and some form of rigid mechanical connection between the two Usually this last is a round tube, but there is no reason why it should not take any shape that the exigencies of mechanics or engineering may demand

Many open-tube telescopes have been built Huygens even built one with no tube at all The objective was placed in a counter-balanced cell with universal joint, mounted at the top of a tall pole He



Design for an open-tube telescope.

drew the axis of the objective into approximate line with the axis of the ocular by means of a cord or wire reaching down to the observer on the ground No objective of modern optical excellence could ever be satisfactorily used in this way The four-foot Melbourne reflector designed and built by Thomas Grubb has an open tube of spirally interlacing straps of steel

The optical advantages of great focal length have long been understood To fully avail one's self of these, it becomes necessary, however, to satisfactorily deal with the mechanical problems of appropriately mounting the parts of the telescope In the large instruments of the present day, this problem presents no mean difficulties and Mr Todd starts out with the idea that a suitably designed open-tube telescope would best satisfy all conditions The principal points to be considered in setting to work on the solution of this problem are, first, to build the tube so that its flexure shall be negligible, and, secondly, to mount the weighted tube so that it can be pointed with ease to any part of the sky Mr Todd says

I have begun my projected telescope, not at the end but in the middle, just as a bridge engineer builds a cantilever (See the accompanying illustration)

The basis of its tube is a cubical section or compartment of steel plates, reinforced as in box girder construction so as to be absolutely rigid and unyielding For a telescope 200 feet or 300 feet long, I would build this central cube about 20 feet square. On two opposite sides it is perforated to allow the cone of rays to pass through, and on two other sides of the cube, at right angles to the cone of rays, are attached the circular bed plates of the bearing pins In other words tube and axis are the same in construction as the ordinary type of transit instrument with shortened axis and a minimum distance between the pivots Needless to say, this is the form which, in the evolution of transit and meridian circle, has been found to give minimum flexure.

As we are *per force* restricted to standard commercial forms of structural steel, the two halves of the tube must be built up, not as cones (the ideal form) but as square pyramids As we have rotation about only one axis to deal with, the flexure of the great tube is easy to handle.

It will be apparent that the alt-azimuth type of mounting follows as a necessary consequence of this evolution, and the altitude motion gives no trouble whatever in either design or practical construction; it is only when we reach the azimuth motion that mechanical and engineering difficulties arise, though they are not wholly insuperable ones.

As we go downward from the telescope to the ground, our troubles increase; and they become a maximum when we reach the plane of junction between earth and mounting Let us now consider the method of dealing with this problem.

What we want is an absolutely smooth positive and yet exceedingly easy motion of a huge vertical shaft. In order to meet those requisites, and treating it as a shaft simply, we should extend its length downward, and confine its motion as a journal between two horizontal friction rings, slipping between roller bearings on vertical axes These rings, with perhaps 100 roller bearings for each, 50 outside and 50 inside, should have horizontal wheels or rollers of large diameter, ground to perfect cylinders. These rings are intended to operate only when the telescope is in use in the wind When the air is still, a smoother azimuth motion would be possible if the friction rings are clamped motionless to the concrete well in which the vertical drum revolves

Then I would float the entire structure in either oil or water, leaving only a few hundred pounds of load on a central button or pintle. In this way a clock of minimum power would suffice to drive a maximum load with perfect smoothness. The expanded vertical axis, then, would be a little like the inner tank of a gasometer when at its lowest point. It should be not less than 50 feet in length, or vertical height; and this drum-shaped form would afford an easy interior construction, insuring absolute rigidity of the vertical towers, which might go down through it, as far as thought best No wind could ever topple the structure over, and the open-air telescope would be safely usable on all but the windiest occasions. By lowering the pintle underneath, and pumping out enough of the flotation to allow the drum to settle down to stationary beds, the drum could be rigidly clamped near the top and bottom, so as to withstand securely all stormy weathers when not in use In case of a severe gale, the telescope would be pointed quartering to the wind, observing carriage and tail-piece unshipped, and tube directed to the nadir. Here the objective would be double-housed against the storm, and the cell clamped firmly This would secure both bearings and open-air pyramids against harmful stress due to excessive wind-thrust, as the gale would strike the structure edgewise.

I have not intended in this paper to deal with the solution of any but the most general problems of this proposed telescope All details have, however, been critically worked out, so that an approximate estimate of cost is available. A 5-foot objective would cost about $25,000, and the entire instrument would represent about double that amount For instance, the weather protection of objective and eyepieces, of altitude bearings and of altitude clamp, quick motion and slow motion; also electric motors for operating the same in both coördinates, and for the requisite variable clock-motion in both altitude and azimuth, as well as for driving the rotary tail-piece on a ball-race. With this arrangement, and an adaptation of Prof. Ritchey's double-slide plateholder with independent rotary motion, micrometric work and even precision photography might be quite practicable All the clamps and motions and clocks may be controlled by electric motors operated from triplicate switchboards in (1) the observing box, (2) the altitude house (not shown on the upright piers), and (3) from the azimuth room concealed beneath the basal drum.

In lieu of observing-chair or rising-floor, observer and assistant ride in a light carriage on the eye-end, swinging on a horizontal ball-bearing axis which passes through the focal plane. This may be wholly inclosed for weather protection, and it can readily be warmed electrically in winter. Should such an instrument ever be erected on a high mountain, as for instance, Fujiyama in Japan, 12,000 feet elevation, where a saddle within the crater provides an ideal location such that wind would rarely shake the telescope, it would be wholly feasible, in fact very easy, to supply the observing box with air artificially compressed to sea-level tension. Thereby we should avoid the disastrous effect of mountain sickness, which not only interferes greatly with one's comfort at elevations much in excess of 10,000 feet, but in consequence of the quickened pulse, tends to shorten the life span of anyone who persists in tarrying long at great elevations, without frequent return to safe and lower altitudes.

An Astronomical Method of Finding an Aeronaut's Position.

WHEN terrestrial objects are invisible, an aeronaut is compelled to employ indirect methods of finding his position. Several such methods have been invented during recent years. Berlingmaier and Marcuse have employed magnetic measurements for this purpose and successful methods of informing an aeronaut of his position by means of wireless telegraphy have been devised. Finally, astronomical methods have been proposed, in which the tedious reduction of the observations is effected by means of special apparatus.

An instrument of this character, invented by Voigt, is shown in Fig 1, and the method of its use is thus

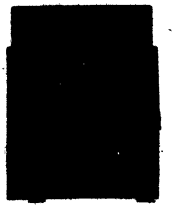


Fig. 1.—Instrument for finding aeronaut's position.

explained in the *Deutsche Zeitschrift fuer Luftschiffahrt*. The principle involved is illustrated by Fig. 2 in which *A* and *B* represent two church steeples rising from a level plain.

If the angle of elevation of the steeple *A*, as viewed from various points of the plain, is measured, we know that all points for which this angle has a certain value α lie on a circle *a* of definite radius, the center of which is the base of the steeple. Similarly, we know that every point at which the angular elevation of the steeple *B* is equal to β must lie on the circle *b*. Hence a point at which the elevation of *A* is α and that of *B* is β must be situated at an intersection of the two circles, i. e., either at *I* or at *II*.

The objects observed from the balloon are not steeples, but stars, and the variation of their apparent altitudes with the balloon's position is due not to absolute distance, but to the curvature of the earth.

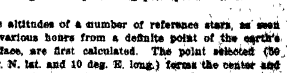


Fig. 2.—Map showing principle involved.

The altitudes of a number of reference stars, as seen at various hours from a definite point of the earth's surface, are first calculated. The point selected (50 deg. N. lat. and 10 deg. E. long.) forms the center and pivot of the revolving map shown in Fig. 1. With the aid of an accurate sidereal clock it is possible to draw the two circles on the map which determine the place of observation by their intersection.

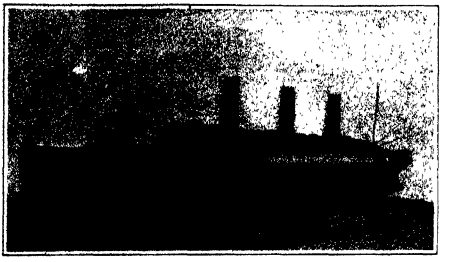
The drawing of the arcs is greatly facilitated by attaching to the map a curve-ruler which can be set accurately to the curvature corresponding to any altitude.

This method, of course, can be employed only at night in clear weather. The principle was employed in 1909 by Dr. A. Brill, who devised an instrument similar to Voigt's.

Curiosities of Science and Invention

Model of a Giant Steamship

IN the SCIENTIFIC AMERICAN of December 17th, 1910, we described the "Europa," now under construction for the Hamburg-American Line. This vessel is nearing completion, and in the meantime its name has been changed to "Imperator." A model of this vessel has been constructed, which is particularly interesting from the fact that it is one of the largest and most complete steamship models ever made. It will be recalled that the vessel measures 900 feet in length as against 860 of the "Olympic" and has a beam of 98 feet. It will carry 4,250 passengers, and some idea of this number can be obtained when we consider that the three largest hotels in New York city have a combined capacity of about 3,385 persons. The vessel is unusually commodious. It will contain a Ritz-Carlton restaurant, a grille room, tea garden and even a ratskeller. All of this will be shown in miniature in the 21-foot model. The model will be lighted with miniature electric lights, so that the spacious dining rooms, Roman baths, and other features of the interior may be plainly seen.



Twenty-one-foot model of the giant steamship "Imperator."

Propeller-driven Suspended Trolley Car

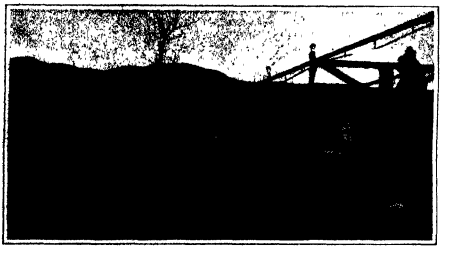
WHILE the use of a suspended car is not altogether new, yet the one now being tried out in Burbank, California, is unique in many ways. The chief point of interest is the fact that it is driven by a huge propeller, itself of novel design, which is operated by a 16 horse-power gas engine. The car is no mere toy model, but a fifty-foot structure of steel and aluminium, which has a carrying capacity of 56 passengers. It is built in a torpedo shape, and while the photograph shows the uncovered ribs, the finished car will be covered with a light, flexible covering, with celluloid windows. In addition to the propeller in the rear, another will be placed in the front of the car, doubling its power, and acting as an auxiliary in case of break-down.

The short length of overhead track, about a quarter of a mile, has made it impossible to test the new device for speed, but it operates perfectly, showing that it is no mere theoretical invention. Forty people have been carried with ease at one time.

The six-foot propeller is of great interest, being a radical departure from accepted forms. It will be noted that the two blades are like enormous fans, being formed of sheet metal on ribs of steel tubing. A number of ingenious devices, tilting planes to lighten the car while in motion, apparatus for raising and lowering the car at stations, etc., have been designed to perfect this new vehicle.



Fountain pen for draughtsmen.



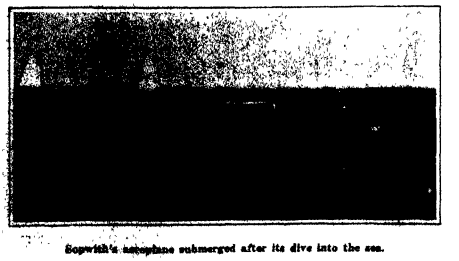
Propeller-driven suspended trolley car in California.



View showing the peculiar fan-like propeller.

An Aviator's Impromptu Bath

FLYING over water has always had a fascination for aviators, and with most of them the closer they can fly to the surface the better they like it. At the Boston meet last summer H. O. Sopwith, the winner of the $50,000 De Forest prize for the first flight by an English aviator in England across the Channel to the Continent, played leap frog with the motor boats in the harbor, much greatly amused their occupants. He followed this up by performing similar feats with the automobiles on the Boulevard, and when he came across a horse the animal is said to have lain down on the ground in fright. While repeating this performance over water and nearing the bathers at Revere Beach last September, Sopwith, who was accompanied by Harry Horton, fellow aviator, Lea Hammond, met his Waterloo. He was barely skimming the surface and had just risen to a height of 15 or 20 feet in order to fly back over *terra firma*, when his motor stopped and the aeroplane dived into the water. Both aviators jumped and escaped without becoming entangled in the wreckage. The aeroplane stopped bottom side up and completely submerged. Our photograph shows the skids, with their wheels, projecting slightly above the surface. The machine was towed ashore by motor boats. In a few days Sopwith had it fully repaired.



Sopwith's aeroplane submerged after its dive into the sea.

A Fountain Pen for Draughtsmen

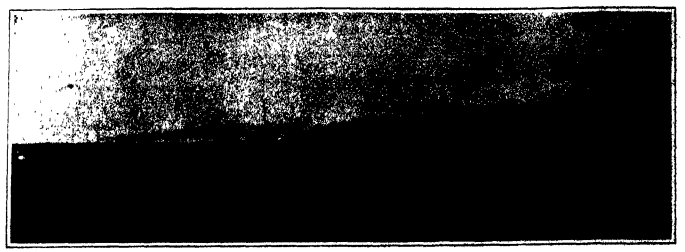
A DETACHABLE container for drawing ink which can be slipped into place on the handle of a draughtsman's pen has been devised by a Los Angeles inventor, and by its use the constant dipping into the ink bottle is obviated. The danger of dropping ink upon the paper is avoided. Likewise. Another advantage is that a number of these containers may be carried in a pocket case, each of them holding a different colored drawing ink, for use in draughting maps, etc. Thus it is possible to dispense with a tray of ink bottles on the table. For filling this device, an ordinary "dropper" is used. As the photograph shows the ink flows from the reservoir through a narrow tube to the pen point, where it supplies an even flow.

Meteorology in American Universities

MR. ANDREW H. PALMER calls attention, in *Science*, to the gratifying increase in the extent to which the science of meteorology is being taught in American universities. Students in medicine, engineering, agriculture and forestry are showing a growing interest in this subject, which until recently was conspicuous by its absence from nearly all university curricula.

At the University of Minnesota instruction in meteorology was first given four years ago. Last year the classes in this subject, under Prof. E. M. Lehnerts, numbered eighty-seven students, being the largest in this branch of science in the country. The University of Wisconsin has a separate department of meteorology, under Mr. Eric R. Miller, the official in charge of the U. S. Weather Bureau station at Madison, which is domiciled in one of the university buildings. Three courses are open to undergraduates, and four to both graduates and undergraduates. At the University of Nevada instruction in meteorology will be offered for the first time during the coming college year. The instructor will be Mr. S. P. Fergusson, late of the Blue Hill Observatory. The University of California is also about to inaugurate courses in meteorology and climatology, under Mr. W. G. Reed, Jr., who for some years past has been an assistant under Prof. R. DeC. Ward, of Harvard. The last university offers five courses in climatology and meteorology, one of which, a research course, is given at the Blue Hill Observatory by Prof. A. L. Rotch, the others at the university by Prof. Ward. At Williams College courses in meteorology have been given for several years by Prof. Milham.

There are a number of other universities and colleges, not mentioned by Mr. Palmer, at which brief courses in meteorology are given by local officials of the United States Weather Bureau, among them being the Universities of Missouri, Ohio, Tennessee, Nebraska, and Washington, Cornell University, Norwich University, and Drury College. At still other universities and colleges the officials of this bureau give frequent or occasional lectures. In fact, educational work in meteorology is recognized as one of the regular functions of the Weather Bureau, the personnel of which includes all the professional meteorologists of this country—with a few notable exceptions.



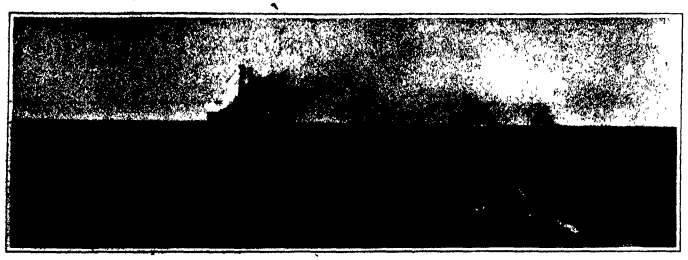
"And so we moved majestically out of Hampton Roads. As the flagship drew away, the vessels, in divisions of four, swung into line, until the fleet of sixteen battleships was strung out over some four miles of water."

A Landsman's Log ... ship "North ... board the Battle-... akota"—I.

By J. ... Walker

This landsman's log is written by the Editor of ... zine Naval Number to appear early in December ... with the Naval Number issued during the Spanish ... written entirely by prominent officers of the Navy ... The leading article, moreover, will be from the pen ... Navy. The illustrations will consist of special ... practice of the Atlantic Fleet on the Southern ... grounds.

SCIENTIFIC AMERICAN as a preliminary to a magazine will be comparable in its size and completeness ... In one respect it will be unique, for it will be ... a specialist in the particular field that he covers. ... Hon. George von L. Meyer, the Secretary of the ... has taken during the recent maneuvers and target ...



"Anyone who has handled the wheel in ships, big or small, will understand that it is no simple matter to hold sixteen vessels of fifteen to twenty thousand tons in absolutely true line ahead."

IT is a far cry from a battleship, lying peacefully in port and "open to visitors," to a battleship at sea, developing over one million foot-tons of energy per minute as, with a savage roar, she flings some four tons of steel high into the air, to land with amazing accuracy upon a target, dimly discernible in the haze of the far horizon

For many years it has been the aim of the SCIENTIFIC AMERICAN to make clear to the people of the United States, by pen and brush and camera, just what kind of a navy it is that flies our national flag. But photographs and printed statements of length, size and speed, serve, at the best, to give an impression merely material and technical To understand what a battleship actually stands for, she must be studied from within and on the high seas Then it is that the stupendous fabric becomes vibrant with throbbing life, and the inarticulate thought and skill that have been wrought into her at the designer's desk, and in forge and shop and dockyard, speak with many voices.

As with the ship, so with the men that man her "All the world loves a"—sailorman, but not all the world can understand him—the essentially human side of his life, the professional enthusiasm, the pride of ship, and his noble devotion to his country and his country's emblem, the flag All this can be grasped only on those rare occasions when, as in the present case, a civilian is privileged, by the courtesy of the Secretary of the Navy, to make the ship at sea his home, sit at mess with its officers; mingle with its men, and absorb the atmosphere—unlike anything ashore—which pervades this highly-organized community of one thousand souls, shut up in its home of steel

At least, so it seemed to the editor as he stepped aboard the particular steam cutter at Old Point Comfort wharf that carried the letters N. D on its bow, and was taken to the gangway of that stately ship, the "North Dakota" The "North Dakota" was one of sixteen battleships that were awaiting the Admiral's signal to weigh anchor and proceed to Tangier Bay in the Chesapeake, there to watch the Delaware (sister to the "North Dakota") shoot away as much as she could of what was left of the old hulk, "San Marcos" ("Texas").

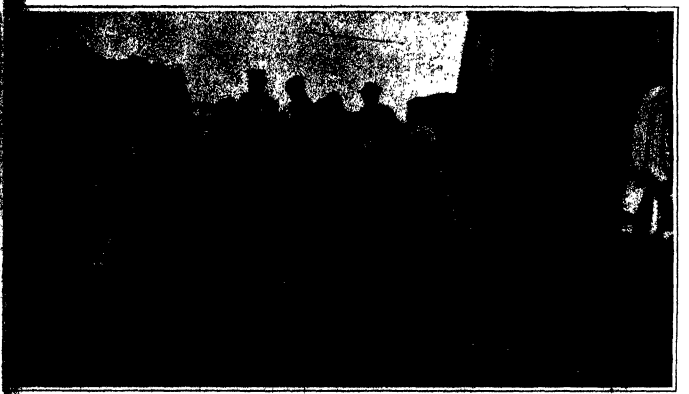
The spacious breadth and long, unobstructed sweep of the main deck of a dreadnought is suggestive rather of an ocean liner than of a ship of war—an impression which is deepened on the "North Dakota" by the yacht-like spotlessness of her deck Here at least we see a survival of one of the traditions of the old three-decker, for the holystone and "washing-down" serve now, as in the days of Paul Jones and Nelson, to keep the man-o'-war'sman busy through many a long hour of the cruise To that distinctively American plan, the center-line placing of the turrets, is due this fine vista of between three and four hundred feet of deck

"Getting under way" is a very different matter from the picturesque confusion, so stirringly described by Marryat and Fenimore Cooper Gone are the coils of rope the rattle of blocks, the creaking yards, the flapping of canvas and the tramp of many feet around the capstan Instead, there is the scarcely audible beat of the capstan engine below decks, and the "chug-clug" of the forty-pound cable links as they come aboard through the hawsepipe and bring the flukes of the 10-ton anchor to their snug resting place under the bows

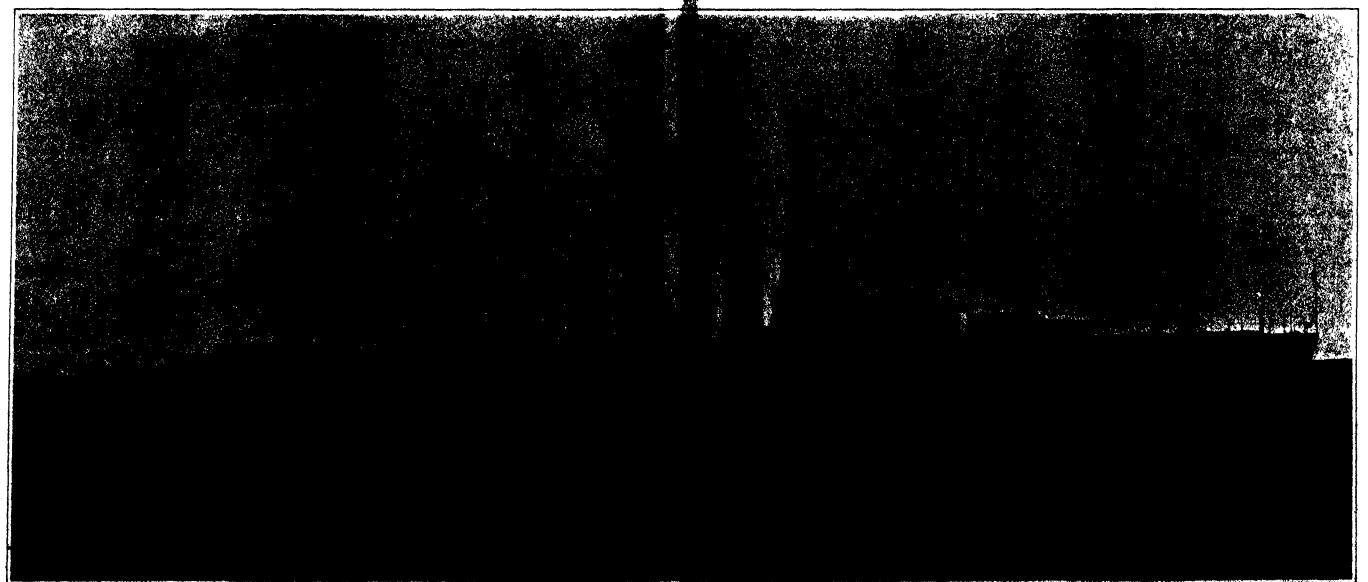
We are the fourth ship in the first division, with the "Connecticut," flagship of Admiral Osterhaus, in the van From sheer force of habit, I listen for the rhythmical throb of the engines as evidence that we are under way, but it is never felt although a glance at the water shows that we are already moving at 10-knot speed. And then I remember that this ship is turbine-driven, and therefore tremorless as far as engine-room vibration is concerned.



"The spacious breadth and long, unobstructed sweep of the main deck of a dreadnought is suggestive rather of an ocean liner than of a ship of war."



"The holystone and washing down serve now, as in the days of Nelson and Paul Jones, to keep the man-o'-war's man busy through many a long hour of the cruise."



Copyright 1906 by Kathryn Becker

Length, 510 feet; displacement, 20,000 tons; speed, 21 knots. ... Tornado tubes, two 21-inch submerged. Officers and men, 930.

THE "NORTH DAKOTA"—... IN THE UNITED STATES NAVY.

Later I understood why it is that the turret officer and gun-pointer swear by the sweet-running turbine, and become impatient when they learn that Washington is still toying with the reciprocating engine and dreaming of pounds per-horse-power economy For the "North Dakota" was well aware that her sister-ship the "Delaware," with reciprocating engines, was keeping station in that four-mile line of battleships, with forty per cent less consumption of coal than was needed for her own turbines The matter came up for discussion in the wardroom mess "Bear in mind," said one of the engineer officers, "that the 'North Dakota,' by a turn of the throttle and the opening of a few valves in the casing, can at a moment's notice jump her speed from ten to twenty-one knots, and keep going for hours at maximum power, with the same sweet certainty of motion, and without giving her engine-room personnel the least additional anxiety And you know what happens," said he, "when a demand for full power is suddenly rung down from the bridge to the reciprocating engines of a battleship" The turbine has never been able to match the reciprocating engine in coal economy at the low cruising speeds, but when 15 knots has been passed, the difference begins to disappear, and at high speed the latest type of turbine (that of the "North Dakota" is of a rather early design) shows a greatly superior economy

And so we moved majestically out of Hampton Roads As the flagship drew away, the vessels in divisions of four swung into line, until the fleet of sixteen ships was strung out over some four miles of water Five hundred yards from foremast to foremast was the distance, which was maintained by turning the propellers of each ship at the revolutions which had been determined in the standardization trials as correct for a 10-knot speed The distance is also checked by triangulation, the height of the mast of the ship ahead being known and the angle subtended observed by stadimeter In foggy weather each ship follows a towing spar, towed by the ship ahead at the end of a cable of the proper length The speed is shown to the ship astern by cones hoisted on the signal yard half way up for half speed, full up for full speed When a change of speed is made, the cone is shifted accordingly—were it not for this the vessels might overrun each other

Any one who has handled the wheel in ships, big or small, will understand that it is no simple matter to keep sixteen vessels of 15,000 to 20,000 tons in absolutely true line ahead, and hold them so for an hour at a time But it was done so well that, from the taffrail of our ship, all that could be seen was the "New Hampshire," flagship of the division immediately astern, which, except at the changes of course, completely shut from view the three miles of ships beyond No "snakes" are possible here; and when it is remembered that a battleship is generally far more difficult to steer than an ocean liner the excellent work of the quartermasters of the Atlantic fleet will be apparent

In the late afternoon we sighted the partly-sunken "San Marcos"—victim of to-morrow's onslaught—her broken masts and tilted smokestack giving her an appearance more tipsy than tragic Signals flutter from the flagship, and the bits of gaudy bunting serve to scatter our hitherto unbroken line In stately sequence the divisions swing out to port or starboard—the head of the line slows down—there is the crash of falling anchors—and the fleet moves with an accuracy that is, to unaccustomed eyes, truly wonderful, into three parallel lines, and each ship, in its appointed position, is snugly anchored for the night

And then, as the shadows deepen there comes a transformation scene that will not soon be forgotten The forbidding, dark-gray mass of each ship begins to sparkle with myriad incandescent lights, row above

(Continued on page 356.)

The Inventor's Department

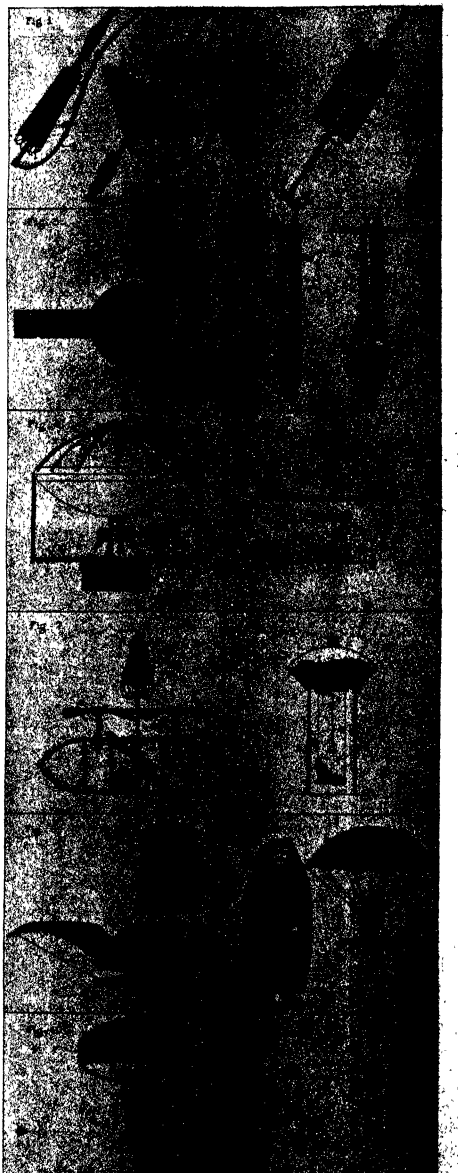
Simple Patent Law; Patent Office News; Inventions New and Interesting

Aeronautic Inventions, Curious and Useful

AERIAL and marine navigation, while in most respects totally unlike, are yet in certain particulars closely analogous, and this is perhaps most clearly observed in considering the smaller auxiliary devices relating to these arts. Although aerial navigation, so far as heavier than air machines is concerned, has only recently been accomplished, the art in a broad sense has been, nevertheless, the subject of patent applications for many years, and a consideration of these patents indicates that not only has inventive genius been active along broad lines of development, but that it has been busily engaged in the perfection of details of construction which now that so great interest has been aroused in the practical side of the art, may be found of great value.

While the first marine anchors were probably crude affairs, consisting of a rock or crooked branch, the art of aerial navigation did not arise until long after marine anchors had reached a fairly high state of development, and aeronautical inventors were thus able to confine their attention largely to the adaptation of these marine anchors to aerial use. Among the first patents granted in this country for an aeronautical device is that to one Bell, dated March 26th, 1850, which among other details shows a water anchor or drag, clearly adapted from marine use, and which, as illustrated in Fig. 1, consists of an umbrella-like structure 2, 3, 4, supported upon a rod 1, the rod being provided with ropes 6 and 8 at its opposite ends. It is evident from the construction shown, that, if the device be immersed in water and attached to the flying machine by the rope 8, the rope 6 being slack, the umbrella structure will remain closed and offer little resistance to travel through the water, while if the rope 6 be pulled taut and rope 8 be slackened, the pressure of the water will open out the umbrella device, thus presenting a large surface to the water and acting as a very effective drag or water anchor. Similar in type, but adapted for land use, is the device shown in the British patent to Alexander of 1893, in which a supporting rod similar to that of Bell's device is provided, but instead of the umbrella structure of the latter, the rod carries a series of backwardly projecting prongs or claws, which, when the rod is towed by one or the other of its ropes, respectively, slide easily over the surface of the ground, or engage with the same and act as a positive anchoring means.

In the year 1854, the Earl of Aldborough, one of the most enthusiastic promotors of aviation of his time, patented in Great Britain a flying machine embodying a multitude of ideas more or less practical, and among his many suggestions, describes an aeronautical anchor of peculiar form, evidently the result of an investigation of the anatomy of a bird's foot, and which he describes in the following terms: "I prefer forming the grapnels with flukes, attached to the stem by joints, and pressed downward by springs in such manner that the flukes shall strike downward when liberated, in a manner bearing a certain resemblance to the talons of a bird, separate cords being attached to each of the flukes, and all these being collected in a small sheath, and so arranged that the flukes can be raised, or permitted to spring downward by either fixing these cords in any convenient way, or letting them go when it is desired that the flukes shall act so as to enter the ground or seize any object." Apparently not satisfied with this device he further perfected it in a patent of somewhat later date wherein he describes a steel-sheathed cable for supporting the anchor, the cable being provided with a device for lessening the effect of sudden shocks, this latter feature being of very common use in marine navigation, being known in that art under the name of "shock-absorbers."



Some curious Aeronautic inventions.

More clearly illustrative of this last feature is a patent to Fiesse, granted May 19th, 1908, which, as seen in Fig. 2, discloses a highly developed form of shock absorber interposed in the anchor rope of a flying machine, wherein the two portions 1 and 2 of the anchor rope are connected with the piston rods 3 and 4, respectively, extending from the pistons 5 and 6, the latter sliding in the cylinder 7, and normally forced toward each other by the compression springs 8 and 9. It is evident from the construction shown, that if the anchor rope be subjected to sudden shock, as by a heavy gust of wind striking the anchored machine, the two pistons will be drawn apart against the action of the springs, thus relieving the rope of the sudden strain.

In the patent to Mackenzie, granted in 1869, is shown an interesting development, wherein the shank of the anchor is provided with a snap-hook, for use, as the inventor states, in place of the anchors when stopping at regular landings, where rings will be provided for their reception. This leads to a brief consideration of aeronautical landing places or stations, and as in many other things aeronautical, the Earl of Aldborough, above quoted, appears to have been the first to make suggestions along this line. Among other things he suggested that such stations be provided with lights and signals for the proper guidance of the aeronaut, which suggestion appears recently to have been carried into effect in European countries. Along this line various patents have been granted, the proper protection of the anchored air ship being in general the main object, the patent to Fechtig, granted in 1910, being, perhaps, characteristic. This patent discloses what in effect is a modified locomotive round-house, having a turntable and radiating sheds, the turntable being inclosed, except at its ends. One of the great difficulties encountered in housing air ships, especially the great dirigibles of the Zeppelin type, has been due to the effect of side winds upon the great expanse of surface, and this the device of Fechtig is intended to obviate, by providing the inclosed turntable which may be presented to any point of the compass for the easy entry of the air ship, and which will protect the same while permitting it to be placed in juxtaposition to its permanent quarters.

A curious device for attaining the same result is that shown in the patent to Gothan, granted in 1910, and which is illustrated in Fig. 3, comprising a balloon shed 1, and a circular platform 2 in front thereof, the platform being provided with a series of vertical openings or jets 3, connected to a supply of compressed air. When these jets are all opened, a circular, vertical wall of air is created, thus effectually shutting out side winds. When it is desired to house a flying machine, the jets are cut off on the side from which the machine approaches, but as soon as the ship has passed through the opening thus formed in the air wall, the jets are again turned on, thus serving to fully protect the ship while being placed in its shed.

While the marine anchor is ordinarily made particularly for use in mud and sticky, soft material, the aeronautical anchor must oftentimes encounter hard, dry ground, and, owing to its necessarily light weight, some modification of the marine anchor must obviously be made if the device is to prove successful. Among the simplest forms of anchor is shown in the patent to Myers, May 20th, 1862, con-

(Continued on page 856)

ALCO
Motor Trucks

How to Judge a Motor Truck

BUYING a motor truck is like hiring a man. You are not interested in the color of his eyes, the tilt of his nose, or his height and weight.

You want to know what this man has done and what he can do.

Just so with the motor truck.

It's what a truck will do that interests you.

Price alone sells few trucks. It's what you "get for the money" that sells them. In other words *value*.

Four things determine value in a truck.

One of them is *good design*.

The only sure way to tell good design is by results.

If a truck is not well designed the owner soon knows. If it is well designed, and if he can use more trucks in his business, he buys more of the same make—naturally.

Thus you may judge a truck by the number of repeat orders or re-orders.

In the case of the Alco Truck 62 per cent. were purchased on repeat orders. Nine-tenths of this number are in the service of firms and corporations listed in Bradstreet's at over $1,000,000.

Before purchasing, many of these large firms carried on extensive experiments to determine which motor truck was best. If only *one* Alco had been purchased by each of these concerns, its place among motor trucks would be clear. But each of these bought more than one. The American Express Company has 40; the Gulf Refining Company 10; Gimbel Brothers 18; the Long Island Express Company 10; and so on.

Among many the Alco has been accepted as the standard—all future purchases will be Alcos.

The second point on which value depends is the *experience* of the manufacturer.

Good design means little unless experience in building is back of it. The thing to know is "how long has the manufacturer been building trucks?" "What does the manufacturer know about the problems of transportation?"

For the American Locomotive Company, builders of the Alco Truck, the experience began in 1905. The Alco Truck was marketed in 1908. The experience of the American Locomotive Company in problems of transportation dates back to 1835 as movers of the world's goods.

The problems of the locomotive and the problems of the motor truck are parallel. One is a power driven vehicle running on rails. The other a power driven vehicle running without rails.

The experience of the American Locomotive Company, as builders of the Alco Truck, is rare.

Value is again determined in the *way the truck is built*.

Little does it matter how well a truck is designed if it is not well built. It becomes a consideration of factory and factory equipment.

The Alco factory represents an investment in equipment of over $4,000,000. In it are built 95 per cent. of the parts of the Alco Truck. It has the most complete heat treating plant of any motor truck factory in the world. It has large chemical and physical laboratories to analyze and test the metals that go into the Alco Truck.

In special and automatic machinery the investment is immense—in jigs and tools alone the investment is over $2,000,000. Many of these tools are not tools in the ordinary sense of the word, but are fine instruments—like those of a surgeon—and are kept in flannel when not in use.

In this factory is the largest drop hammer in the world. It weighs 250,000 pounds.

The fourth consideration in determining value—and one that is most decisive—is the *responsibility* of the manufacturer.

The safest thing in the world to buy is reputation. Buying a truck from a manufacturer without reputation or reponsibility is like making a loan without security.

The American Locomotive Company is capitalized at $50,000,000. It dates back to 1835 as movers of the world's goods. It has built 50,000 locomotives. It builds 60 per cent. of all the locomotives in the world. Its reputation is indelible.

These four considerations—Good Design, the Experience of the Manufacturer, Good Building and the Responsibility of the Manufacturer—provide an "acid test" for judging a motor truck.

There are a few trucks that can stand this test.

Of these the Alco Truck is one.

You should investigate the Alco for one vital reason, if for no other: —*latent* experience—of its builders in manufacturing power driven vehicles.

Write for the new catalog.

AMERICAN LOCOMOTIVE COMPANY, 1888 Broadway, New York

Builders also of the Alco 6-Cylinder and 4-Cylinder Motor Cars

Movers of the World's Goods since 1835



Capital, $50,000,000

Your Three Greatest Tire Troubles Ended



No-Rim-Cut Tires

10 Per Cent Oversize

With Double-Thick, Non-Skid Treads

They end rim-cutting forever. They avoid the blowouts due to overloading. They prevent skidding and do away with chains.

These No-Rim-Cut tires, in the past two years, have increased our tire sales by 500 per cent. Over 700,000 have been sold.

These tires now dominate the field. With tens of thousands of motorists they have cut tire bills in two.

Now they come with this ideal Non-Skid tread.

The Final Tire

After 12 years spent in tire making—after ceaseless improvements—we believe that the Goodyear No-Rim-Cut tire is now pretty close to finality.

Our greatest invention—controlled by our patents—has ended rim-cutting forever. That was, perhaps, your chief worry and expense.

By making these tires 10 per cent oversize—without extra charge—we added 25 per cent to the average tire mileage.

By 12 years of tests on tire-testing machines we have brought our formulas and fabrics close to utter perfection.

And now we have added a Non-Skid tread worthy of all the rest.

We never hope to see a much better tire than the Goodyear No-Rim-Cut today.

The Winter Tread

Most of you know the No-Rim-Cut tire—the oversize tire—which has come to such immense popularity.

The control of this tire has thrice trebled our tire sales within two years. The sales to date exceed 700,000 tires. And, to meet the demand, we are increasing our capacity to 3,800 per day.

Since 1906 our experts have worked to create for this tire a perfect Non-Skid tread. Now we have it. We offer you now, for winter use, your highest ideal of a tire.

An Extra Tread

The Non-Skid feature is an extra tread, vulcanized onto our regular tire. Thus the tread is made double-thick.

This extra tread is exceedingly tough, as impervious to wear as a rubber tread ever can be. It remains effective over enormous mileage. When it does wear off there's our regular tread below it.

The tread is made up of deep-cut blocks, which grasp the road surface with countless edges and angles. The blocks widen at the base, so the load is spread over as wide a surface as it is with the smooth-tread tire. The grooves can't fill up.

This double-thick tread, because of its thickness, reduces danger of punctures by 30 per cent.

Chains, as you know, are ruinous to tires. Metal projections, too. Rubber and metal never combine, and their friction soon wrecks a tread. Short, soft projections are temporary. Here is a tread that's immensely efficient, and a tread that endures. And it comes on the tire you are bound to demand when you know the facts about it.

Please look it up. This tire is made for your safety and economy. Learn what it means to you.

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No-Rim-Cut Tires

With or Without Non-Skid Treads

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Aeronautic Inventions, Curious and Useful

(Concluded from page 343.)

sisting merely of a circle of sharp pegs projecting downwardly from the bottom of the car and converging toward the center, thus when forced into the ground by the weight of the aeronaut, clutching a large section of earth and acting as a powerful anchor. Mr. Barnes, in a patent granted in 1892, has improved upon the above device to the extent of substituting long, corkscrew-like rods for the straight pegs and providing means for revolving these by power from his motor, thus obtaining a tremendous grip upon the ground.

Another form of earth anchor as illustrated in the German patent to Boinet, consists of a hollow shell having a pointed end and adapted to be forced into the ground, the shell being provided near its lower end with openings through which may be projected curved arms which enter the adjacent soil and thus obtain a powerful grip thereon. Similar, but with some modifications in structure, is the device shown in the patent to Thomas, dated July 24th, 1906, and illustrated in Fig. 4, the manner of operation of which is so obvious as to require no explanation. The acme of inventive ingenuity along this line must, however, be conceded to an Englishman, Mr. Jackson, who proposes to attach a cannon to the car of his machine and shoot dart-shaped anchors therefrom into the ground.

Among other interesting devices might be mentioned that shown in a patent to Lake, granted in 1908, in which is shown the car mounted upon three wheels, the two rear wheels being free to swivel in the manner of furniture castors, while the front wheel is provided with long spikes upon its periphery and may be held stationary when desired. When thus held, the spikes project into the ground, thus forming a pivotal point about which the whole structure is free to turn, and thus the machine will always head into the wind after the manner of a weather vane.

A device in which the anchor is put to a seemingly anomalous use is shown in a patent granted to Mueller, in 1909. Here the anchor is not used for the purpose of retaining the machine in a fixed location, but as a means for causing its proper ascent. In this case the anchor is held by an endless cable passing over pulleys on the machine. When about to start, the anchor is firmly embedded in the ground. Upon starting the motor, the machine endeavors to rise, but being restrained by the anchor, describes the arc of a circle about the anchor as a center until the cable becomes so nearly vertical as to release the anchor, when the machine is free to take flight, by this means permitting the machine to rise from its restricted quarters, and to pass over obstructions in its immediate vicinity.

As every well equipped marine vessel is provided with life-preservers and life-boats for use in emergency, so will the flying machine of the future be provided with means for assuring the safety of the aeronaut in case of accident to his machine, and in the provision of such means the inventor has not been idle. The majority of such devices are modifications of the well known parachute, but it is interesting to note the variations in and methods of adapting this simple device for use in connection with other aerial craft.

It is well known that if the gas be suddenly allowed to escape from a balloon when at a great elevation, the balloon envelope will, in many cases, assume of itself, a parachute form within its netting, and fall slowly to the ground. This fact has not been overlooked by the inventor who has endeavored to assure this action by giving the balloon a special form or construction, a typical example of which is seen in the patent to Chanoz, granted in 1906 (see Fig. 5), in which the balloon is of lenticular form, comprising a metal rim 3 to which the car is attached and provided with a set of rigid ribs 6 converging to a central collar 5. The upper and lower sheets of oiled silk forming the gas bag are attached to the rim 3, [illegible] either the upper or lower sheet be accidently ruptured and the gas escape, the material of the bag will be forced by the air pressure against the ribs 6 which will support it in parachute form and thus prevent a precipitous descent.

In a like manner, by taking advantage of a special form of aeroplane, the inventor has converted this type of machine into a more or less effective parachute, as for example in the French patent to Weld (Fig. 6), wherein an end view of the plane is shown. Here the main plane 1 is in the form of a half cylinder, open downwardly and at its ends. The ends of the plane are, however, provided with curtains 3, normally folded, but which may be extended to close the ends of the machine, thus forming a sort of parachute.

Of course only a specific type of aeronautical vehicle lends itself to the above construction, and so independent parachutic devices have been produced. Although the ordinary aeroplane has proved capable under skillful management, of descending safely from great heights without motive power, yet the inventor has made assurance doubly sure by providing the aeroplane with a folding parachute adapted to be spread in case of accident by the air itself, one of the most recent of these devices being that of G. F. Myers, in which the aeroplane consists of a series of super-posed ring-like or annular planes. Upon the upper of these planes lies a normally folded parachute attached by a series of restraining cords to the plane, and being also provided with a controlling cord. By pulling the latter, the parachute is drawn beyond the edge of the plane, permitting entry of air between the plane and parachute, the latter thus being expanded and rising to the full extent of the restraining cords.

The helicopter and flapping wing types of machine, however, seem to offer little chance of safe landing in case of failure of the motor, and as the inventors of this form of machine evidently expect them to go up, so they have, with great unanimity, provided them with parachutes to prevent them from coming down too suddenly, and of these devices, one of the earliest, patented to Quinby, in 1861 (see Fig. 7), is typical. Here the machine, which is of a composite type, having valved, beating wings 1, and helicopter wheels 2, is provided above the latter with a normally folded parachute 3, adapted to spread itself if the machine begins to fall and thus prevent too rapid descent.

While all the above devices have for their object the saving of the entire machine from the effects of a fall, attention has also been given to the provision of parachutes for saving the person of the aviator alone, and typical of such devices is that patented to Griepe in 1907, covering an air ship embodying among other features a trap door in the bottom of the car communicating with a compartment containing a parachute provided with a releasing device, whereby in case of emergency the operator may suspend himself from the parachute and abandon the air ship to its fate.

It is well known that parachutes cannot always be depended upon to open automatically when required, and to ensure their proper opening, M. Pichou has taken out a patent in France covering the device shown in Fig. 8, wherein 1, 2, indicate the frame of the flying machine, 3, 4, a circular connecting member, 5, a circular box resting on 3, 4, the box being provided with a central opening in its bottom, 6 is a receptacle filled with explosive and resting on the bottom of the box 5 and covering the opening, and 7 is a trigger operated by a cord 8 for detonating the explosive contained in the receptacle. Attached to the bottom of the receptacle by cords 9 is the seat 10 for the aeronaut, and attached by cords to the top of the receptacle and normally nested in the box 5 is a parachute provided with cover 11 to prevent the cords from disturbing it. In case of accident, the operator merely pulls the cord 8, thus exploding the charge in the receptacle, which ejects the parachute from the box, when it immediately becomes effective and pulls the aeronaut, seat and all, up through

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Of course most of the above devices require some preliminary action on the part of the aeronaut in order that the parachute device may become effective, and in order to avoid this a still further arrangement has been devised wherein the parachute forms a part of the clothing of, or is attached directly to the person of the aeronaut. The Earl of Aldborough, before referred to, appears to have been the originator of this idea, and describes a parachute to be worn about the neck and reminding one by its general appearance of the old fashioned neck ruff, but of exaggerated proportions, and provided with stays leading to a belt at the waist. Of a very similar character are the devices patented to Wilke, in Germany, and to Mayer, in Great Britian, illustrated in Figs. 9 and 10, respectively, wherein the former shows a sort of vest embodying the parachute and having stays leading to the wearer's belt, while the latter shows a parachute attached to the aviator's coat and adapted to be folded over the head and shoulders when not in use, thus serving as an additional protection against the weather. A further modification is seen in the patent to Ulmer, January 31st, 1911, which consists of a hat for the aviator, provided with a pocket in which is folded a parachute the cap and parachute being attached by a cord to the aviator's belt. In the event of an accident to the machine, the aviator will immediately remove his hat, when the air current, caused by the descent, will inflate the parachute and the aviator will be saved all further cause for anxiety.

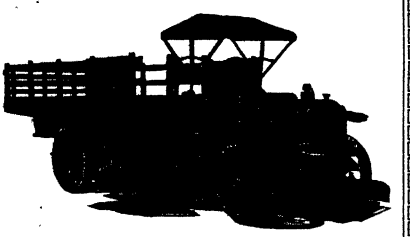
In passing, might be mentioned the device patented to Mr. Oppenheimer in 1879, and illustrated in Fig. 11. Although designated a fire escape, it would appear equally advantageous for aeronautical use, the padded shoes 3 being without doubt a highly desirable feature, especially in the estimation of the luckless pedestrian upon whose head the wanderer from space might chance to descend.

As in the operation of the submarine boat, it is of primary importance that the depth below the surface be always known, so in aeronautics it is of interest to know the height above the earth. Although many devices have been devised for registering the height or the vertical movement of flying machines, some of which have been noted in a recent number of this paper, the records of the Patent Office appear to be singularly devoid of such devices.

Among the few patents relating to this subject is that to Chaubassargues, granted in France, which shows (see Fig. 12), a device for indicating ascent or descent, comprising a vertical tube 1, having flaring open ends, a paddle wheel 2, projecting into the tube, and an indicator wheel 3, having graduations upon its periphery and driven by the paddle wheel. When the machine is ascending the air enters the tube at the top, rotating the wheel 3 clockwise and moving the indicator wheel to indicate upward travel, while in descending, the reverse takes place.

A second device for the same purpose but of different construction is shown in another French patent, that to Brisson, wherein a series of balls are allowed to fall upon a resilient support carrying an arm provided with a pencil, which last rests upon a constantly rotating, paper-covered drum. It is stated that so long as the machine remains at a given level, the trace of the pencil upon the drum, caused by the impacts of the falling balls will lie in a straight line, but if the machine commences to rise the falling balls will strike the support sooner than when the machine is stationary, thus causing the pencil trace on the drum to vary from the normal straight line, the new pencil trace being above the normal, while if the machine should descend, the reverse operation will take place.

Along somewhat the same line may be noted the device patented to Pennington in Great Britian in 1908, wherein a mercury barometer controls, through an electrical circuit, the direction of thrust of a screw propeller, and by this means serves to keep the machine at the same level, and



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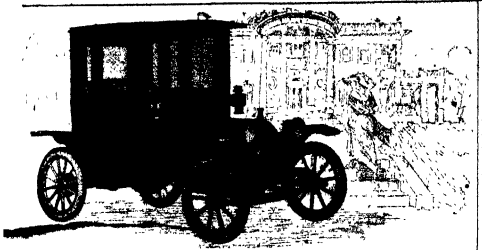
THE economy of the good motor truck is found in its greater capacity—its better speed—its ability to keep agoing. A motor truck is no more tired on the last trip than on the first—it is just as efficient. In any other department of your business you know what efficiency means, but in your delivery plant, that vital link between your factory or your business and the customer, you have not demanded efficiency. White motor trucks will make it efficient. We know it, because they are doing it—not for a few firms—but for scores in every kind of business under every possible condition—for the largest, shrewdest and most capable firms in the country. They are not deceived—you simply have not been shown.

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the somewhat similar mechanism patented by M. Phillippeau in France. This embodies a suitable case containing a spring-driven winding drum upon which the valve cord of the balloon wound, the rotation of the drum being normally prevented by a friction brake Mounted also within the case is an aneroid barometer, the indicator arm of which serves to make and break an electric circuit in which is included a magnet, the armature of which forms the aforesaid brake for the spring drum. When the balloon reaches a predetermined height, the barometer arm closes and completes the circuit thus withdrawing the brake from the drum and allowing the latter to revolve, thus opening the valve and permitting the gas to escape. The purpose of this device is to prevent accident due to the failure, or inability of the aviator to open the valve at the proper time

The self-registering aneroid barometer, in its ordinary form, appears to be capable of registering the ultimate height attained, provided this height is maintained for an appreciable time, and so far as the writer has been able to ascertain, none of these devices having any special modifications of structure for aeronautical use has been made the subject of a patent. It would appear, however, that devices of this character might be devised especially for aeronautical use, embodying great rapidity and sensitiveness of operation, together with freedom from the effects of motor vibration, and at the same time having indicators and scales of such size as to be readily discernable from the operator's seat, and doubtless as the art becomes more highly developed the demand for such instruments will be fully met by the active mind of the inventor.

An Inventor as a Congressman

IT is of considerable interest to inventors to know that the House Committee on Patents includes in its membership a man of such experience in patent matters, as an inventor and patent lawyer, as William H. Wilder, in view of the flood of bills that are being presented to the Committee with all kinds of changes proposed to our present patent system.

Mr. Wilder was born May 14th, 1855, in Belfast, Me. His inventive ability was probably derived from his father and grandfather, who were mill men, his mother being a school teacher. At eleven years of age he removed to Massachusetts, worked on a farm; went to school in the winter, and was, in turn, a wood chopper, worked in a card mill, prepared chair stock for the chair factories of Gardner, and when but a little over sixteen, went into business for himself as a painter, and has been an employer ever since. While in the painting business he climbed most of the meeting-house spires in and around Gardner. He entered the oil stove business in a small way, and in the first years of his experience he made the patterns and all the other parts, and directed personally the making of tools and dies and the like, for a period of twenty years. He has taken out more than fifty patents covering his own inventions.

Mr. Wilder is a member of the Bar of the Supreme Court of the United States. His inventions have revolutionized the oil stove industry; for he is the inventor of the modern oil stove. He has taken great interest in denatured alcohol, having visited Germany to investigate this business.

During a period of thirty-eight years as an employer of labor he has never had a strike, lockout, or disagreement with his employees.

Notes for Inventors

A Folding Step for Street Cars.—The Public Service Commission for the district in which New York is included, has been considering the betterment of the equipment of surface cars. The Metropolitan system is now experimenting with a folding step for the *pay-as-you-enter* type of cars. The present step is too high, and there have been some accidents.

United Shoe Machinery Patents.—How huge is the part played by patents in the profitable industry of

LEGAL NOTICES

PATENTS

If you have an invention which you wish to patent you can write fully and freely to Munn & Co. for advice in regard to the best means of obtaining protection. Please send sketches or a model of your invention and a description of the device, explaining its operation.

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this country has undergone in the last half century is shown by the proceedings of the United Shoe Machinery Company. This "trust" owns at least a thousand and possibly fifteen hundred United States patents. A mere list of them alone covers 48 pages of legal cap. In some instances many patents have been granted to one inventor. John B. Hadaway has received about 75 patents, and Thomas G. Plant also a large number. The "trust" also owns hundreds of foreign patents.

A New Hose-supporter Wanted.—A man of our acquaintance says he does not like a hose-supporter which encircles or grips his leg or one that is connected with and drags down on his undergarments, both such forms being on the market. Cannot someone invent a supporter that will hold the top of a sock up and avoid both of the above described objectionable features?

A Machine for Making Imitation Stitches.—John B. Hadaway of Brockton, Mass., assignor to United Shoe Machinery Company, has secured three patents, No. 1,003,450 to No. 1,003,452, for machines for making impression or imitation stitches. The patent, No. 1,003,450, has an indenting wheel which is rolled back and forth over the work and is also caused to feed the work during its rolling movement. The patents, Nos. 1,003,450 to 1,003,452, were issued September 19th, 1911, on applications filed, respectively, July 18th, 1904, September 15th, 1904, and March 22nd, 1905, so that the applications were pending in the Patent Office from six to seven years. This inventor, John B. Hadaway, is one of the most prolific inventors in the shoe machine art and was the patentee of a patent, No. 521,978, for a machine for the same general purpose as the three above specified. The patent, No. 521,978, was granted June 26th, 1894, and consequently expired last June. The application on which this expired patent issued was filed in the Patent Office March 28th, 1894, and as the patent issued June 26th, 1894, the application was pending less than three months, in striking contrast to the three patents just issued.

Protecting from Electrolysis.—Albert B. Herrick, in a patent, No. 1,003,604, describes a method of preventing an earth conductor adjacent a grounded return by alternately connecting the earth conductor to the grounded return and to a source of negative electromotive force.

Sterilizing Earth Around Posts.—Patent post holes have long been humorously referred to in connection with machines for grinding smoke, left-hand wheel barrows, and other imaginary inventions. It has remained, however, for a Budapest inventor to make what is probably an important improvement relating particularly to post holes, seeking to thus preserve the wood of the posts. Instead of applying preservatives to the wooden posts, railroad ties, sleepers or other wood exposed to the action of the earth, he treats the earth which surrounds the wooden post in such manner as to destroy all insect, germ and fungus life by soaking the earth with a suitable sterilizing liquid. The process is termed "Feristerilization," and is claimed to be especially useful in rural and other remote districts in which it is inconvenient to obtain wood which has been treated with creosote or similar preservative.

Cork Plugs for a Novel Purpose.—Cork plugs are utilized in a cotton gin roller, patent No. 1,002,842, to William H. Harries of Pawtucket, R. I., assignor to Empire Duplex Gin Company of New York city. The roller has a number of radial recesses, and the plugs of cork are fixed in the recesses and project beyond the surface of the roller. The cork plugs are described in the patent as constituting the operating cylinder surfaces of the roller, and the specification is interpreted by manufacturers and in otherwise advantageous, since the cork plugs being fixed in the recesses, may be readily removed when worn or damaged.

Reward of New York City.—Mr. Churchward, assignor to General Electric Company. To assuring the desired result, Mr. Churchward provides the motor with a series and a shunt field winding, and means for connecting the motor as a series motor for running and for connecting the shunt field winding in circuit and for reversing and shunting the series field winding when the motor is regenerating.

A Coaster Bar for Roller Skaters.—What is termed a roller-pole toy has been patented, No. 1,003,537, to Thomas S. Spivey of Cincinnati, Ohio. It consists of a pole, having a roller at one end and a handle at the other end, the rider sitting astride the pole on a seat. In front of the rider there is provided on the pole a cross bar between the seat and the handle, the knees of the rider bearing below the brace bar, so that when the rider is sitting, much of the weight is taken off the handle.

A Fireworks Auxiliary.—In patent, No. 1,003,411, to Haden Herbert Bales of Ashcroft, British Columbia, we find an airship frame with a battery of pyrotechnical rocket cylinders, adapted to operate as an auxiliary to the main propelling mechanism. Means are provided for adjusting the position of the rockets to regulate the direction of the discharge, and also a selective mechanism for firing any particular one or all of the rockets, as occasion may require.

An Illusion Apparatus.—A patent, No. 1,003,905, with Roy McHill of Somerville, Mass., as inventor, is for an apparatus for producing an illusory effect, in which a vessel is supplied with water from a pipe discharging from above and an exhaust pipe leads upward from the vessel into the first pipe so it is hidden by the water discharged into the vessel, a pump, out of sight, being suitably connected with both pipes to properly circulate the water

Three Patents to Charles Francis Jenkins.—Charles Francis Jenkins of Washington, D. C., has secured patents, No. 1,003,750, for a gas engine starter; No. 1,003,751, for a railway tie of metal and concrete with a special rail gripping device, and No. 1,003,752, for a gas motor starter.

Legal Notes

A Void Patent.—The Regnier patents, No. 678,514, for a vegetable or fruit slicer and method of making the same, and No. 744,107, for a slicer to produce such slices, *Held* void for prior public use. Handy Things Company v. Tucker & Dorsey Manufacturing Company (C. C. A.), 188 Fed. Rep. 68.

Substantive Patent Law and Procedure.—In a hearing last year before the Patent Committee of the House of Representatives, one of the most distinguished patent lawyers of the country said, in commenting on the substance of the patent law and the practice thereunder, as follows:

"The patent law, the substance of the law, in this country I think is admirable. I do not think there is any branch of law where the substance is in better shape than in the patent law to-day. When you come to procedure, that is, the way in which cases are tried, nothing could be worse."

Warning to American Trade-mark Proprietors.—In a note, published by the Bureau of Manufactures, American Minister John B. Jackson, Habana, Cuba, gives a warning and extends some good advice to owners of trade-marks, as follows:

"Under the provisions of the existing Cuban law with respect to trade-marks any person whatsoever can legally register well-known foreign trade-marks and deprive the foreign owners of such trade devices of the benefits arising from their possession. This has happened recently in several instances involving patent or proprietary medicines. When the third party has once registered the trade-marks in due form under the law the only redress possible for the rightful owner or originator is to bring action for fraud, and proof of fraud is naturally very difficult under such conditions, even in the most obvious cases.

"The registration of trade-marks is a simple and inexpensive matter in Cuba, and rightful owners may easily prevent difficulty by having their trade-marks registered at once wherever there is any likelihood of entering the Cuban market. It is urged that American manufacturers take note of this matter and by forestalling the registration of their trade designations by pirates in the future avoid future annoyance."



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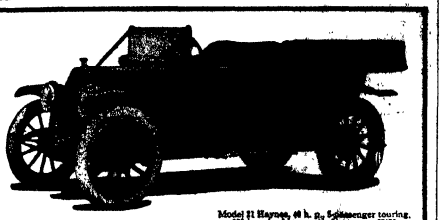
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Price $300, including Bosch Magneto, Schebler Carburetor, and Propeller. Ready to Run and Guaranteed to Fly. Bleriot XI, Demoiselle, Nieuport, Morane, Grade Monoplanes, and Curtiss and "Baby" Wright Biplanes.
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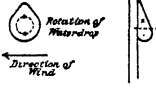
Correspondence

[The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.]

Whirling Rain Drops on the Car Window

To the Editor of SCIENTIFIC AMERICAN:

On a rainy day the observing traveler will doubtless be surprised to find that every rain drop on the car window by his side becomes a miniature whirling vortex as long as the car is in motion at speeds above ten or fifteen miles per hour. The effect is most easily noticed when the rain drops have collected enough fine particles of soot to make their motion apparent. While the largest drops show the greatest movement, the rotation can be detected even in droplets down to one-eighth inch in diameter



when the train is running at high speed. The direction of rotation for each individual drop is the same as that of the car-wheels, the cause of the motion doubtless being due to wind friction against the lower rounded side of the water drop. The pear-shape form of the drops, especially the larger ones, where the attraction of gravity for the mass gets the better of the surface tension, which tends to hold the spherical form, results in a greater rotational moment at the rounded bottom than at the thin, wedge-like top, so that the wind friction at this lower surface produces movement in the same direction as the car wheels below.

O. H. C.

Chicago, Ill.

Metric Wire Gage

To the Editor of SCIENTIFIC AMERICAN:

From a very reliable source I learn that the Committee on Weights and Measures of the next Congress will report a bill doing away with our old-fogy system of having different-size measures for different articles. For instance, we have a large quart for berries, beans, peas, etc., and a smaller quart for liquids. In the matter of weight we have avoirdupois, apothecary, and troy, no two of which are alike. Equally absurd as the above is the great number of non-standard wire gages, none of which has a base that is get-atable as a starting point, and no two that agree thereafter. To overcome this "conglomeration" in gages, the writer some time ago designed one (for both metal and wire), that is standard throughout. It takes for its base the same angle (of one degree) upon which the metric system of measurements is founded. It starts at the apex of this angle for its first number, and gives it as No. 0, which is really no



no substance, however small, can enter there. To locate No. 1, we measure along either side of the angle one millimeter; for No. 2, measure two millimeters from No. 1; for No. 3, go three millimeters from No. 2, and so on *ad infinitum*. It will be noticed that each gage number indicates the number of millimeters intervening between that number and the next smaller one below, and that every number is of good commercial size.

To illustrate its practicability, suppose a party in some isolated place had a piece of wire and wished to order more like it, but had no gage. All he would have to do would be to lay out an angle of one degree, insert his wire and measure the number of millimeters from its point of contact to the apex of the angle, then point off the gage numbers as above, and he has the exact size—a thing that cannot be done with any other gage made.

The accompanying drawing plainly shows for itself. The engraved angle in the center is exaggerated for purposes of illustration, but it represents an angle of one degree, on one arm of which are millimeters, and on the other the gage numbers, engraved simply to show the principle of the system, while on its outer margin are the usual slots cut out for the different sizes, with the gage numbers at each separate slot, all of which is as simple as "rolling off a log."

MERRITT W. GAUSWOLD.

Highwood, N. J.

Twenty-seven-knot Armored Cruisers Urgently Needed for the United States Navy

To the Editor of SCIENTIFIC AMERICAN:

Having just read in your issue of July 22nd your most interesting comparison of the United States and German navies, I would like to have your explanation of the policy of the United States navy, which omits the dreadnought armored cruiser type as found in the British and German navies, and of which type Japan is now said to be building more than the battleship type.

With even one ship of the British "Lion" type, an admiral in charge of our ten dreadnoughts of the "Texas," "Wyoming," "Utah," "Delaware," and "Michigan" classes, could send his one 30-knot dreadnought to locate the enemy. Our light 24 to 26-knot scouts of the "Chester" class, and our 23-knot armored cruisers of the "Washington" classes, would obviously be completely at the mercy of British, German, or Japanese dreadnought cruisers of 28 to 30 knots speed, and it would be murder to send our good fighting men out in such ships.

Would not these navies possess a great advantage on this account?

How could our admiral "find the enemy," and destroy him when the enemy, by means of their dreadnought cruisers, would be able to keep in touch with the movements of our fleet, while our admiral would be in the dark?

Ought not our next two ships to be of the "Lion" type, or at least one of them?

A. B. IRVINE.

St. Marc, Haiti.

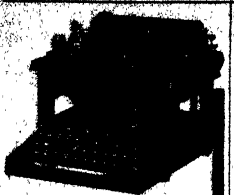
[Our correspondent has placed his hand on a weak spot in the make-up of our fleet. For some years to come our annual naval programme should call for two battleships and two armored cruisers of the "Von der Tann" type. Our "Chesters" (25 knots) and "Washingtons" (21 knots) would be helpless in the presence of the 26 to 28-knot 12-inch gun armored cruisers of foreign navies. —Ed.]

Foreign-built Dredgers Built to the Order of the United States

To the Editor of SCIENTIFIC AMERICAN:

There is announcement made that a Glasgow firm has just launched the United States dredger "Norfolk," built to the order of the United States [illegible] mint.

The order was placed [illegible] and [illegible]



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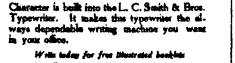
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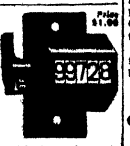
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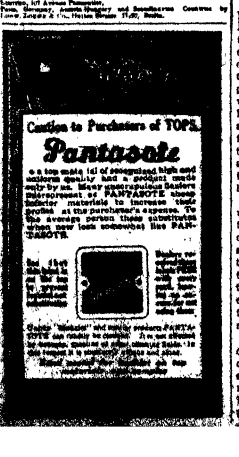
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can builder made tender, and it was so much higher than the foreign builders offered to build for, that President Taft felt justified in vetoing the resolution of Congress prohibiting work for the United States to be done in foreign yards. The difference between the foreign bid and the one bid tendered by the American company that bid, amounted to almost $100,000

In other cases the government exercises its power and avails of foreign tonnage, rather than pay the American "scale" of freight charges. Annually several thousand tons of coal for the account of the government are transported from Virginia to San Francisco and Portland, Ore., foreign tonnage can be had to move it for sixty per cent of what the American-built tonnage charge. The government contracts with the foreign tonnage, and the coal is moved on the low rate.

If an American company has coal to move from an Atlantic American port to an American Pacific port, it is compelled to use American tonnage and to pay the American freight scale

The government of the United States refuses to obey its own laws. The United States government shows that the navigation laws tend to extortion The United States government compels the people of the United States to obey the navigation laws and to pay extortionate freight rates.

Is it not time to consider the revision of these navigation laws, that have been in effect for over one hundred years, and which have practically driven us out of the foreign shipping trade and been the means of extortion and monopoly in the domestic? If the government of the United States refuses to obey its navigation laws, why should the citizens of the United States be compelled to?

There is a remedy for this state of things; allow American registration for foreign-built American-owned tonnage, limited if necessary to foreign trade, and put all iron and steel and shipbuilding material on the free list We will then be able to compete in building with foreign yards.

As long as iron and steel are highly protected, and as long as iron and steel made in this country is sold from $8 to $11 per ton cheaper to foreigners than to our home builders, we will be unable to meet the competition of foreign builders of tonnage.

There is depression in United States trade. Many of our yards are on short time We want a revival of our American merchant marine The surest way to bring it about is to reform the navigation laws, and allow Americans the privilege of "free ships" the same as Great Britain and Germany allow to their people.

Also we should break the monopoly that exists in the iron and steel trades by taking off all duties.

Chicago, Ill. CHARLES DEPESSE.

General Factory and Machine Shop Lubrication

IT is a matter of common knowledge among well informed factory managers that the power loss due to the friction developed in the moving parts of machinery, is considerable. In the endeavor to reduce this absorption of power experiments have been and are being made with types of roller and ball bearings Lubrication, however, is a question just as important. As a consequence of the failure to appreciate the necessity for the investigation of lubricating problems and choice of lubricants, the possible saving in this direction is frequently very large.

A considerable reduction in power can usually be effected by simply changing the oil. These reductions will in many cases be approximately the same as the substitution of roller or ball bearings for the ordinary type of bearing. This being the case, it seems advisable to consider the elements bearing upon efficient lubrication in a practical way and the necessities for the right quality of oil in the right place.

When reductions in power to the extent of ten or fifteen per cent in the driving of workshop machinery and shafting are easily brought about by the re-establishment of oils or the use of more suitable lubricants, and when this reduction of power can in many cases be brought to

The Warner Is the Official Road Map Speed Indicator

THE WARNER was used in compiling the routes in the Automobile Blue Book, King's Official Road Guide and the dozens of Official Guides put out by Automobile Clubs and map makers.

Note how this affects *you*—

You tour unknown territory occasionally. You must depend on some reliable map or ask your way at frequent intervals with unsatisfactory results. Some people delight in directing Automobilists to take the worst roads or the wrong road.

With the Warner Auto-Meter on your car the road map directions are easy to follow. It is impossible to go wrong. Where the route book says: "21.6 miles—four corners. Turn right at country schoolhouse; bridge over creek ¼ mile away"—you will find the four corners and the schoolhouse just when the route book says—at 21.6 miles, no more and no less.

Note this little human interest story which bears on this point.

Early in June a car drove up to our Beloit factory. It bore an Ohio license number. The owner was driving. With him were his wife and two daughters. One of the first things he said, after introductions and greetings were over, was: "I had only had my car a week when we decided to drive from Columbus to Madison, my old home, in the auto. And do you know we *haven't yet asked a direction from a single human being*, relying entirely on our route book." The directions came out right because the routes were surveyed—and interpreted—by Warner Auto-Meter.

This case is only one of many which have come to our notice.

There are conditions when touring becomes a nightmare instead of a pleasure.

The different route book and map makers have themselves advertised the fact that the Warner was adopted by them as their "Official Speed Indicator," because after testing all makes they found the Warner in every sense the sensitive, accurate, dependable and reliable instrument of precision we have claimed it to be.

When an *inaccurate* and unreliable speed indicator is used to interpret an *accurately surveyed* map or route, disaster results.

In such cases where the route book says: "49.8—forks in road with big elm in angle. Take the left branch" You are likely to find nothing in sight but open prairie or you may be approaching a four corners or small town So you are *lost* unless you stop to ask questions, and this is what a route book is intended to prevent.

The route book maker's principal tribulation is explaining to owners of unreliable speed indicators that their routes, compiled at a cost of thousands of dollars, are *right* and that no one using a Warner speed indicator to interpret them has cause to complain.

A little Warner device which adds still further to the joys of Touring.

All Warner instruments of the dial type (see illustration) have two resetting buttons for the trip mileage figures. One resets the figures to 000.0 with a single turn. The other works on the tenths of a mile only, making it possible to turn up any desired mileage on the trip scale This makes it possible to drive around the boulevards or through the parks at any point and then in a few seconds set the mileage back to correspond with the route book readings Those who tour regularly will appreciate this refinement

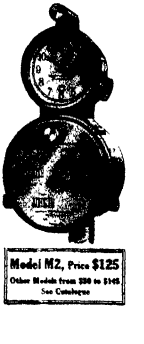
The Warner costs more than inferior speed indicators for a very good reason.

Those who look for satisfaction on the bargain counter are certain to be disappointed We have all had our lesson. Supreme quality is worth its cost And—as in other things—the Warner is also the *cheapest* speed indicator obtainable if you base its price on *years of service* or *miles of travel*. It is a permanent investment because it remains as sensitive, accurate and reliable as when new for many years—or many hundred thousand miles.

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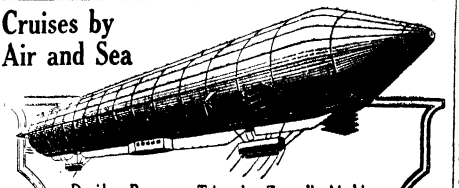
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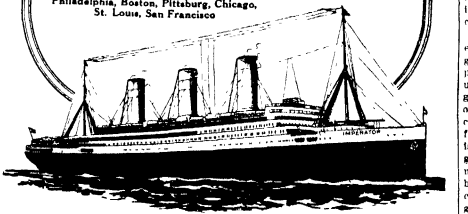
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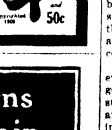
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But that isn't all. That bit of soft B & B wax gently loosens the corn. In two days the corn comes out. No pain, no soreness, no inconvenience—no feeling whatever. The callous simply separates itself from the toe, and the trouble ends.

Five million corns annually are removed in this way—removed by Blue-jay plasters. Get a package—end yours, too. Don't temporize with corns.

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B protects the corn, stopping the pain at once.
C wraps around the toe. It is narrowed to be comfortable.
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as high as thirty or forty per cent, it is very evident that the investigation of this subject is worth considerable time and trouble.

Because a good quality of oil is bought by the purchasing agent of a company it is not always true that this oil is used to the best advantage in the works. As an example: If an oil similar to a high class dynamo oil is bought by the purchasing agent in large quantities for a general machine shop and, as frequently happens, a considerable portion of this oil be mixed with either cylinder or black oil—to suit the operator's idea of what he imagines is the proper compound for general lubrication of machinery—the mixture is not at all adapted to the work which it is made to perform; and (if the original oil is being mixed with cylinder oil, as is sometimes the case) the cost is greatly in excess of what it should be, and the efficiency of the oil as a general lubricant is considerably impaired, even though the cost has been increased.

It is impossible here to make any statement as to the use of different classes of lubricants for certain purposes, as the conditions of speed, pressure, class and arrangement of machinery, the devices employed for the lubricating, etc., have considerable effect, not only upon the oil which can be used but upon the character of oil which is most efficient for the work.

It may be stated, however, that the use of light oils is possible only where special mechanical devices are arranged for the purpose of lubrication or where the shafting has the proper ring oiling bearings, etc. It is also true, as a rule, that floor machinery cannot be lubricated satisfactorily with the same oil that is used for modern shafting. Floor machinery itself can very well be divided into three classes, each class being lubricated with a different oil.

In the lubricating of plants of a general character it is customary to use grease or solid lubricants for some purposes. In some cases greases can be used with economy, but an excess of grease will act against the actual economy of operation on account of the increase in power required to overcome friction of the parts where the grease is used. It is invariably the case that grease will require the development of more power than necessary where oil is being used, and the only features that commend grease as a lubricant are its greater cleanliness and the fact that less attention is required in the lubrication of the various units.

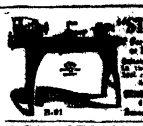
Where bearings have some mechanical fault of construction or alignment, or are roughly fitted, or where it is not worth while to produce a proper fit, they absolutely require grease as a lubricant; but even under these conditions such bearings can be lubricated in some cases more cheaply by the application of heavy cylinder oil.

In considering the efficiency of lubricants for general purposes, the fact that grease will reduce the bearing temperature of an improperly constructed or mechanically imperfect bearing should not be taken as indication that the same results will obtain from the use of grease through the entire plant, where probably almost every other bearing is in good condition.

It is very frequently the case, however, that grease is placed in a shop for general lubrication on account of just such a misconception from its work upon an imperfect bearing, the imperfections in the bearing not being taken into consideration. The fact of the matter is that the reduction of the temperature in this case which follows the use of grease in the bearing is the result of a special condition and does not illustrate the general applicability of the material.

The amount of oil required to provide proper lubrication in order to reduce the friction loss as nearly as possible to a minimum is so small that if it were possible thus to reduce the amount used the oil accounts of every company would be cut in half and in a number of cases possibly a large reduction would be undertaken.

The high oil accounts as a rule are due to the waste of oil. In order to reduce this waste and bring it down to a proper proportion of the amount of oil necessary for the lubrication of the machinery, etc., it is absolutely necessary that appliances should be installed which will enable the



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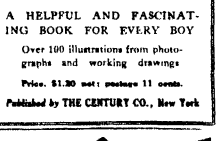
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By FRANCIS A. COLLINS

Author of "The Boys' Book of Model Aeroplanes."



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proper care to be exercised in the use of lubricants.

The installation of the gravity feed system, of appliances for catching the waste oil as it comes from the bearings, etc., so that this oil can be cleaned and re-used, the use of ring oiling bearings pad lubricators, sight feed pressure pumps and pressure lubricators are all necessary for the elimination of the waste of oil and the consequent reduction in the amount paid out on account of lubrication.

If the gravity feed system be employed, the oil can be used indefinitely, and, besides the economy secured from the re-use of the oil, additional power economy is obtained from the fact that a large amount of oil can be used by flooding the bearing and consequently securing a good free film of oil between the surfaces which assist in the efficient lubrication and reduction of temperatures.

All devices which are installed for the purpose of saving otherwise waste oil require that the oil used for lubrication shall be excellent in quality. A poor quality of oil will not stand continuous use without entirely breaking down and consequently defeating the very purpose for which it is to be used—that is, the reduction of loss by friction.

A great many shops, while they are heated during the working hours in winter, are apt to become cold during the night, and in order to provide efficient lubrication under these conditions the oil should be of such a character that it will remain fluid during cold temperatures. Under these conditions it is necessary that the oil shall have a (low) cold test, of at least 25 degrees above zero, in order that the lubrication be effective.

The science of lubrication is a very intricate one and the problems to be handled are so many and involving as they do the mechanical conditions of the plant, the physical and chemical characteristics of the oil and the partly physical and partly chemical action arising from the conditions under which they work, that it is impossible to do more than state these one or two general points in an article of this kind. In fact it is necessary for effective lubrication that this matter should be handled by a man who is expert in both the theory and practice of the science, otherwise even the most effective devices employed for the purpose of saving the waste oil and allowing efficient lubrication will be of little avail in the actual reduction of lost power by friction.

Practically the only people who have had a large and varied experience in the science of lubrication are the experts employed by the large oil manufacturing companies who have had the opportunity of gathering data regarding the conditions presented in practically all the variations possible, and are therefore constantly accumulating information showing that the systematic and careful study of lubrication has resulted in a reduction of the lost power and consequent expense in the operation of machinery, and in further reductions in the amount of oil used; to the benefit of users of power of all kinds; and in addition to this fact such a study has resulted in the production of oils better suited for the purpose of lubrication from a manufacturer's standpoint so that the continual tendency is to provide possibilities of further reduction of the loss due to friction in moving parts of the machinery and other apparatus

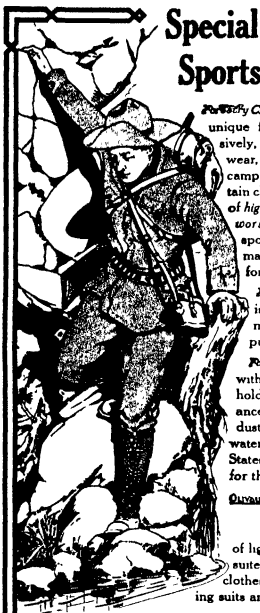
The Business Side of Aviation

(Concluded from page 837.)

a novelty and are rapidly becoming a necessity. Even special clothing for aviators is now being made, leather being a favorite material Numerous kinds of map cases, portable buffets, helmets, searchlights, and horns are offered specially for aeroplaning.

There is also much done in France in the manufacture of instruments for aeronautical work, speedometers, recording barographs, altiscopes, sketching cases and specially mounted compasses.

Coincident with the large trade in aeroplane supplies and in aeroplanes themselves, there has arisen a large number of firms in France, acting as aeroplane brokers, receiving orders and transmitting them to the manufacturers. Dealers in second-hand machines and supplies are also springing up, but their field is



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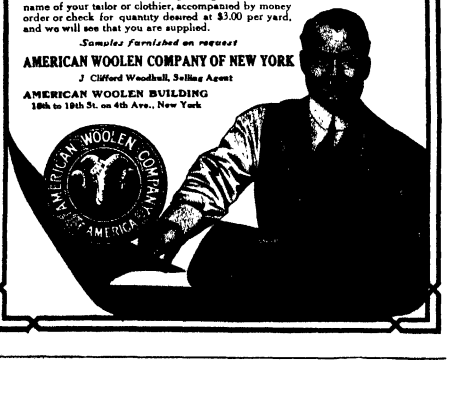
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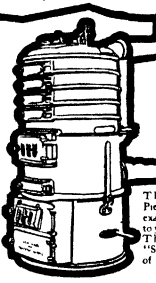
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still very limited—a second-hand aeroplane is a dangerous investment at best.

Even the profession of the law is called into the aeroplane field to a great extent the number of flourishing patent attorneys giving an indication of the amazing number of patents applied for.

The model aeroplane also plays its part in the industry and many model manufacturers sell several hundred of these toys at prices ranging from $1.50 to $20 Gliders, motorless aeroplanes, are also manufactured and sold, especially in England, where "gliding" is becoming a hobby

The number of corporations applying for certificates in various States, although only a few survive, gives a further indication of how active the field of aviation is becoming from the business side.

The Art.

It is not only in the trade and manufacturing of aeroplanes that a large volume of business is found Activity of another kind, but of equally great importance exists in the cultivation and practice of the art of flying.

A large number of men are employed by private individuals to fly their machines for them, and many manufacturers have a regular staff of expert birdmen to test, exhibit and instruct others on their machines

Few persons appreciate the actual cost of flying and what it means to keep as delicate a machine as an aeroplane in perfect order Atwood in his great St. Louis-New York trip, is said to have made over $6,000 in prize money It is understood on good authority that this falled by a large margin to pay his expenses

To keep an aeroplane in perfect trim two or three trained mechanics are required The wages of these men are $30 to $35 a week each, and often more

A Burgess-Wright aeroplane of the kind used by Atwood requires four gallons of gasoline an hour in flight, the gasoline costing about 20 cents a gallon, Oil, motor accessories, spare spark plugs, etc., also cost a considerable amount. The aeroplane, itself, practically used up in this grueling campaign, cost $5,000

In addition Atwood has large expenses for rents of fields and hangars, as well as damages to property, and in his own traveling expenses, his manager's salary, etc., are found other sources of expenditure The grand total amounts to well over $8,000—a rather expensive way to travel

At the recent aviation meets many of the contestants suffered heavy financial losses In most cases, however, the losses fall on the manufacturer who supplies the machine and who employs an expert to handle it.

The earnings of some of the aviators at the recent Boston meet are: Ovington, $11,782, Milling, $6,200, Sopwith, $6,022; Grahame-White, $5,224, etc., down to Ely, $150; and others with no winnings at all.

At Nassau, Sopwith won $4,850, while Atwood and Lieut Arnold won only a few hundred dollars.

There are other sources of revenue, however, in the actual flying of aeroplanes.

Passenger carrying at $25 to $50 a head is becoming customary in this country In England and France, regulation booking offices have been opened where reservation can be made The price is from $10 upward.

Manufacturers and aviators also make a considerable charge for instruction of pupils In France, $150 is the usual price for a full course. If breakages are to be included, the Voisin Company charges $500

At many aerodromes in England, where their location seems to be definite, hangars and the privileges of the field may be rented at $600 a year. The rent of the hangars in France is about the same.

The business of aviation is thus growing and the possibilities that are offered in the flying field for the development of industrial enterprises can probably be as little conceived of at present, as could the future of railroading one hundred years ago.

A Landsman's Log

(Concluded from page 354.)

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superstructure, the effect is that of a many-storied hotel. Ship beyond ship, over miles of water, stretches this floating city of twelve thousand souls. The thousands of incandescent lights become millions as they are reflected from the ever-restless water of the Chesapeake, emulating in numbers and beauty the flashing myriads in the over-arching dome of the autumnal night.

The "stern realities of war" seem very far removed, as I drink in the quiet beauty of the scene and catch the strains of well-remembered music faintly heard from a band on some distant ship The mood was deepened when a message came to the captain and the ward-room mess that night, inviting the officers to a moving-picture show—of all things in the world! But there it was; the screen hung between a 12-inch turret and the whaleboat davits; the machine at the taffrail; the crew crowded picturesquely on one side of the screen, the officers seated forward on the opposite side It was an audience that in size would have comfortably filled an average theater; for decorum it would have matched any house on Broadway The pictures were largely reminiscent of those western plains and mountains from which so many of these fine young sailormen had come. Certainly there was nothing to conjure up in that quiet hour the sights or sounds of war—and yet—once—the glint of the lantern that flashed along a pair of 12-inch rifles that stretched their black forty-five feet of length ominously above the screen "Yes" I thought, "these are perfectly consistent with the restful scene that flickers on the canvas below Guardians of the peace they are—pledges that 90 millions of people, peace-loving and prosperous, are determined that their peace and prosperity shall endure through the years to come, unbroken and unassailed!

An Opportunity for the Farmer in the United States

THE profitable cultivation of basket willow in the United States is an opportunity that should not be overlooked by farmers who are anxious to add to their income by the cultivation of a crop on land that is now lying idle. Basket willow, like a number of other farm crops, is one of the smaller opportunities so often lost sight of in the general desire to grow crops on a large scale with the thought that there will be corresponding large returns. American farmers are apt to overlook the combined results from many small crops that can be handled with comparatively small expense European farmers keep a strict account of these, and in the aggregate often reap a rich reward for their thrift.

The demand for basket willow as an article for manufacturing basket ware and furniture is constantly growing. In this connection it is interesting to know that the United States is a very large purchaser of basket willow rods from France, Germany, Holland, Belgium, and Austria, while there are millions of acres of waste or undeveloped lands in this country capable of producing enough basket willows to supply the world There is an annual importation of approximately one million pounds of basket willow rods ready for the basket-makers' use. Approximately four times this amount is imported in the form of manufactured basket ware and willow furniture. The total value of this material is about $300,000, which might as well be paid to the American farmers if they knew how to grow the crop successfully.

That the growing of basket willows is a profitable farm crop may be seen from the figures of yield contained in a United States Forest Service circular entitled "Practical Results in Basket Willow Culture" An acre of well-managed basket willows, calculating the yield at 3,000 pounds of dry sap-peeled rods at 5 to 7 cents a pound, will give a net profit of from $75 to $135 per acre. The cost of cultivating and harvesting basket willows is variously estimated at from $50 to $75 an acre. Of course the above figure of yield is above the average for the United States, but even if the crop should be only two-thirds of that obtained on the experimental farm at Arlington, Virginia, the net profit would still be far better than that of most other farm crops.

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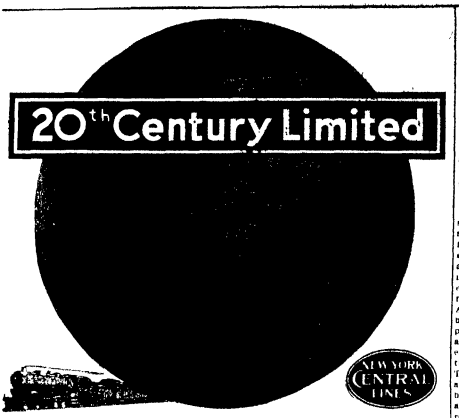
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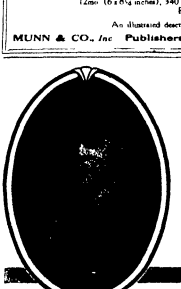
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At the International Municipal Congress and Exposition, Chicago, September 29th, *Edward F. Croker, Ex-Chief of New York City's Fire Dept. who spent 27 years in the service, 12 years as chief, said:*



"IF we are to better conditions, we must realize that 'fireproof' is not fireproof" as it is understood today. The literal definition remains, but many crimes have been committed in its name.

There is but one principle to fireproof construction irrespective of the kind of structure. To have fireproof buildings, architects and owners must throw aside precedence and eliminate the use of combustible and semi-combustible materials in their construction

. . . . . If there were still an absolute necessity for its use, if it could not be replaced with steel, as it has been in many modern constructions, it would then be well to attempt to conceive of something better I am opposed to the use of wood in any form in fireproof buildings and the law ought not to permit its use.

To me there is a fascination about steel interiors. It constantly emphasizes the absurdity of fire-fighting, for how can fires rage if they have nothing to feed upon?"

Interviewed, Ex-Fire Chief Croker said, "You are at perfect liberty to use my talk partially or entirely and apply it to your products I have watched your development since you first originated cold drawn steel interiors with great interest. I have nothing more to say My address and the fact that my private residence will be equipped throughout with The Dahlstrom Products is as strong a recommendation as I can make."

Ex-Fire Chief Croker's interview does not refer, does not include, any of the Dahlstrom doors now in use for the safety of the Equitable Building. A. C. They remain for storing securities the enormous value of all combustible materials in the building. A fair note to ask for the product, it must have in

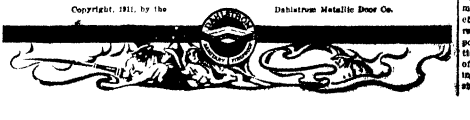
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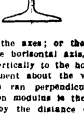
Notes and Queries.

Kindly keep your queries on **separate sheets** of paper when corresponding about such matters as patents subscriptions, books, etc. This will greatly facilitate answering your questions as in many cases they have to be referred to experts. The full name and address should be given on every sheet. No attention will be paid to unsigned queries. Full hints to correspondents are printed from time to time and will be mailed on request.

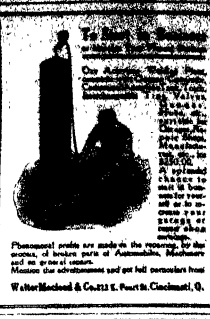
(12548) C A. E H says: I have seen it stated that the mouths of some rivers are higher than their sources. I can see that this may be true of rivers such as the Mississippi, which flow toward the equator through a number of degrees of latitude If the water is actually farther from the center of the earth at the mouth, will you kindly explain the force or forces acting upon it to raise it? A. All rivers which flow south in the northern hemisphere, or north in the southern hemisphere, are farther from the center of the earth at their mouths than at their sources The earth's diameter is 26 miles longer through the equator than it is from pole to pole The theory is that the earth was once soft and in rotation, and bulged at the equator by centrifugal force The earth has cooled and become solid, but the centrifugal force remains The yielding water takes the position which the rotation of the earth requires it to take The very definition of a level surface is one which is parallel to the surface of still water The Mississippi River flowing south does not take this position It is below that position at its mouth really down to the Gulf of Mexico, although in so doing it goes farther from the earth's center The name of the force raising it farther from the center of the earth is "Centrifugal Force"

(12549) A J I says: Kindly settle the following argument for me A friend of mine contends that after water has assumed the solid state as ice, provided the pressure is constant, its temperature will remain at 30 deg F as long as the temperature of the surrounding medium remains below 32 deg F and that if the surrounding medium was to go down to 8 deg F., the temperature of the ice would remain constant. I contend that the temperature of the ice varies with the temperature of the surrounding medium, as also does its volume A Water, in the solid state is no different from any other solid All solids rise and fall in temperature as the place in which they are is heated or cooled Every body knows that ice cream, which is largely frozen water, is cooled much below the freezing point and packed to make it keep Ice also expands and contracts by heating and cooling, just as iron or any other solid does People are misled by the fact that ice cannot be heated much above 32 deg Fahr. It melts, but so does every other crystalline solid when it is heated to its melting point All such substances cannot be heated above the melting point any more than ice can The peculiarity of ice is that it melts at a very low temperature Most crystals melt at a much higher temperature than does ice Ice when below 32 deg becomes dry It is easy to see the difference between ice cold air and ice in warm air The writer has cooled ice to the temperature of liquid air, more than 300 deg Fahr below zero It crumbled into very small pieces by its contraction at that temperature

(12560) A F H asks: Will you please explain through Notes and Queries, the following terms as applied to steel rails Horizontal Inertia, Vertical Inertia, Moment of Inertia, Section Modulus, Radius of Gyration? A Consult one of the books on mechanics, such as Merriman's "Mechanics of Materials," ($5 if ordered from our Book Department), for a full explanation Briefly, "moment of inertia" is a term signifying the sum of the masses of the particles of a body each multiplied by the square of its distance from the center of inertia which may be a point or an axis In the rail section herewith, the sum of the masses of the particles multiplied by their distances squared, would be the polar moment of inertia if all the distances ran together at



the crossing of the axes; or the moment of inertia about the horizontal axis, if the distances all ran vertically to the horizontal line *AA*, or the moment about the vertical axis, if the distances ran perpendicular to that axis. The section modulus is the moment of inertia divided by the distance of the most distant particle from the pole or the axis of inertia. Its value, like the values of the moment of inertia, may be found in the pocketbooks, for all standard rail sections. The radius of gyration is the distance from the pole or the axis (as the case may be) of inertia to that point at which, if all the mass of the body were concentrated, the moment of inertia would be the same as for the original shape.



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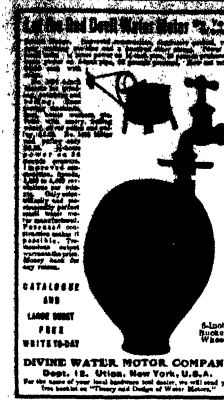
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PRINCIPLES OF PHYSICS. By William Francis Magie, Ph.D., Henry Professor of Physics in Princeton University. New York: The Century Company. 1911. 570 pp.

The author's name is sufficient guarantee for the general excellence of the book before us. It is very remarkable how much information has been condensed into a volume so small, considering the boundless scope of the subject. Moreover, the information is thoroughly up-to-date. In turning over the pages we have found the Brownian movement and Perrin's recent work duly considered in their relation to the kinetic theory. Similarly the chapter on "Electricity and Matter" presents in simple but clear terms some of the fundamental facts upon which the modern views on the subject are based. A brief note is also devoted to the phenomenon of radioactivity There is little criticism to offer. The opening paragraph of the first chapter attempts a definition or description of "physics," and can hardly be said to be quite successful There are some things that can not be rigorously defined, and probably the scope of physics is such. One is almost tempted to say that "physics" is all science which has not been for one reason or another (not necessarily a very good reason) been given some other name —and even that may be physics One can not help regretting that it should be necessary or desirable in a book of this kind to avoid the use of the calculus, often at the cost of much complication in work can be done in elementary physics with a small stock in trade of the methods of the calculus, that it would seem well worth the while to arrange the student's courses in mathematics in such manner as to avoid the necessity of working out from first principles every case of 'proceeding to a limit." In the development of the absolute temperature scale, the ideal gas is introduced as a "guide" for the choice of the temperature function which shall enter into the expression for the efficiency of a heat engine It appears preferable to develop this function without reference to any specific properties of the working substance Making use of an "ideal gas" (which does not exist) gives an appearance of unreality to the argument, and is apt to leave in the mind of the young student an impression that the argument in some way depends on the properties of the "ideal gas," whereas what one is particularly anxious to impress upon the learner is the fact that the efficiency is wholly independent of the properties of the working substance. The general scope and arrangement of the book may be gathered from the main headings, which are as follows Book I—Mechanics 1 General Notions About Forces 2 Statics 3 Dynamics 4 Mechanics of Liquids. Book II—General Properties of Matter 5. Gravitation or Mass Attraction. 6 Elasticity 7 Capillarity 8. Gases 9 Friction 10 Diffusion Book III—Sound. 11 Sound and Sound Waves 12 Sounding Bodies. Book IV—Heat. 13 Temperature and Heat 14 Thermal Relations of Bodies 15 Heat and Energy Book V—Light 16 Geometrical Optics 17 Physical Optics Book VI—Magnetism and Electricity 18. Magnetism 19 Static Electricity 20 The Electric Current 21 Electricity and the Ether 22 Electricity and Matter

BUNGALOWS Their Design, Construction, and Furnishing With Suggestions also for Camps, Summer Homes, and Cottages of Similar Character. By Henry H Saylor Philadelphia The John C Winston Company 4to, 188 pp; illustrated Price, $1.50 net.

Bungalows, springing up mushroom fashion all over the land, have imparted a not unpleasing variety to our domestic architecture Mr Saylor's papers are aptly introduced by Burgess Johnson's "Bungal-Ode." The advantages and limitations of the true bungalow are impartially set forth, and under the heading "Types" we are given, in beautiful plates and succinct description, more than a score of houses scattered from the Atlantic to the Pacific coast Bungalows for seacoast woods, and hills are given separate consideration, and chapters on "Plan," "Foundations," "Walls," "Roofing," and "Interior Finish" tell what the prospective builder needs to know Even the fireplace, furnishings, lighting system, water supply and sewage disposal are treated at some length, and the setting of flowers, vines and shrubs, an important matter from an artistic point of view, is the subject of a final chapter The large pages, fine paper, clear plates and good printing make the book a desirable one to own, and the common-sense manner in which the author presents his knowledge and advice places the seal of practical value upon what would still be a work of beauty and suggestive inspiration even without so informing a text

PRACTICAL SILO CONSTRUCTION. By A. A. Houghton. New York: The Norman W. Henley Publishing Company, 1911. 69 pp.; 20 illustrations. Price, 50 cents.

We have before taken the opportunity to mention favorably the earlier issues of these "Concrete Worker's Reference Books." The treatise in hand, No 3 of the series, comprises directions for constructing concrete silos of various types. Full data and working drawings are given, and segmental forms and molds are shown for the building of monolithic and block silos.



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Aeronautics

Death of Edouard Nieuport.—M. Nieuport, the builder of the fastest monoplane in the world, died from a fall sustained on the 15th ult. An account of his and other fatal accidents, together with a description of his monoplane, appears in the current SUPPLEMENT.

Helen's Record for the Michelin Trophy.—Emmanuel Helen, on a Nieuport monoplane, flew 1,252.8 kilometers around a 104.4-kilometer circuit on the 8th ult., in France. Deducting from his total time—14:07.50—the six stops he made, his time in flight was 13 hours and 17 minutes—an average speed of 58.6 miles an hour. His previous record of August 26th was 700 miles in 13:47:19.

The Aviation Meet at Nassau Boulevard.—The international aviation meet on Long Island was successful, and resulted in several new records. Chief of these was the record of endurance with two passengers, which was raised from the 1 hour 38 minutes 40 seconds made by Mamet at Rheims in 1910, to 3 hour 54 minutes 22 2/5 seconds. The new record was made by Lieut. Milling, in his Wright biplane, and in making it he also won a prize of $1,000 offered by the Hotel Knickerbocker for 100 minutes in the air with two passengers. The best previous American record, made by Beaty at the Chicago meet, was 1 hour 18 minutes 22 seconds. Besides races between Sopwith, on a Blériot, and Grahame-White, on his Nieuport, exhibition flights were made by Dyott on two Deperdussin monoplanes and also by Mlle Helene Dutrieu, on her "baby" Farman biplane. Miss Matilde Moisant outflew Mlle. Dutrieu by soaring to a great height in her Moisant monoplane, and flying far across country, while Miss Harriet Quimby made a record cross-country flight in 39 minutes, ascending to a height of 2,500 feet.

The Transcontinental Flight.—After delays of three or four days, owing to breakages and unfavorable weather conditions, the two aviators who attempted to cross the continent in opposite directions in Wright biplanes—Robert B. Fowler and Calbraith P. Rodgers—finally resumed the flight on September 28th. Fowler had twice previously tried to scale the Sierras, but without success. In one of these attempts he experienced difficulty in climbing to the necessary elevation, while in the second one, after attaining a height of nearly 7,000 feet and getting to a point within 15 miles of the summit, his motor stopped and he was obliged to glide back to a suitable landing place. He alighted at Emigrant Gap. His third attempt, on the 28th ult., resulted in reaching an altitude of but 1,500 feet on account of choppy cross currents of 20 miles an hour or more which drove him back to earth after a 20-minute flight. After this experience Fowler abandoned the race.

Rodgers's Progress in the Flight Across the Continent.—Rodgers's machine was so badly damaged by contact with a barbed-wire fence on the 24th ult. that nearly four days were required to repair it. He left Red House, N. Y. (where the accident occurred) at 10.35 A. M. on September 28th and alighted on the race track at Meadville, Pa., at 12:20 P. M., after having covered the 104 miles from Salamanca to Meadville in 106 minutes. This included circling the former town and hovering above Meadville at a 3,000-foot elevation for several minutes in an endeavor to locate the Country Club. About 10½ gallons of gasoline were consumed on the trip. A fresh start was made at 1:20 P. M. but the aviator was obliged to alight shortly after at Warren, O., on account of the oil tank not having been filled by his mechanics. A skid was broken by a concealed ditch and it was 4:30 P. M. before he set out for Akron. He covered 30 miles to Kent, a small place some 10 miles from Akron, in 40 minutes and was able to alight successfully in a field which he was barely able to discern on account of darkness setting in. He covered 204 miles altogether. During the next four days he made some progress and reached Huntington, Ind., 142 miles from Chicago. In starting on October 3rd, a down current drove him to the ground and smashed his machine once more. On the 5th he resumed the flight and covered 133 miles to Hammond, Ind.

Science

Constituents of the Body.—Our body may be said to weigh about 70 kilograms, or say 154 pounds average, the various constituents being as follows:

	Kg.	Lbs. av.	Per cent.
Muscles	30.4	67.02	43.5
Fat	13.3	29.33	19.0
Skin	12.4	27.34	17.8
Bones	12.2	26.90	17.5
Brain	1.6	3.31	2.2
	69.8	153.89	100.0

There are 45 liters = 45 kilograms or 99 pounds average of water and 25 kilograms = 55 pounds of solid matter; the latter being composed of 14 kilograms = 30.8 pounds of albumen, 7 kilograms or 15.4 pounds of fat, 3½ kilograms or 7.7 pounds of salts, and 0.7 kilograms, or 1.54 pounds of sugar.

The Work of the Human Heart.—The average human heart is a suction and force pump of remarkable capacity and durability. Each of its two chambers contains, on an average, 75 cubic centimeters or 4.575 cubic inches; the total contents of 150 cubic centimeters or 9.15 cubic inches being discharged 81 times a minute, corresponding to a delivery of 12,150 cubic centimeters (12.15 liters) or 741 cubic inches per minute, 729 liters or 25.73 cubic feet per hour. Expressed in U. S. gallons, the average human heart pumps through it each hour 192.6 gallons; each day, 4,622.4 gallons, each year 1,687,176 gallons; and in the adult life time of a man living to the age sung by the Psalmist 8,435,880 gallons. The pressure against which this fluid is pumped is equivalent to that of a water-column 2½ meters or say 8 feet 2.42 inches high; otherwise expressed, about 0.242 atmospheres or 3.55 pounds avoirdupois per square inch.

Strength of Human Bone.—Fortunately the human skull, although composed of bones is elastic—much more so than one would think. The average male adult skull, in fact, is so elastic that it may be compressed laterally in diameter by a blow or by pressure, applied at the center of area, at right angles to the surface at that point by 1½ centimeter or about six-tenths of an inch; recovering its original diameter and form, without breakage. The material of which our bones are made is so highly resistant that a cylindrical piece thereof only one square millimeter or 0.00155 square inch in area (i. e. only 1.128 millimeter or 0.044 inch in diameter) has a tensile strength of 15 kilograms or 33 pounds avoirdupois, figuring out at about 21,300 pounds per square inch. A similar sample of hard wood tested in the same manner held only 10 kilograms—that is, bone has 50 per cent more tensile strength than wood. A single bone fiber is shown in the Hygiene Exhibition, Dresden, supporting a weight of 5 kilograms or 11 pounds avoirdupois.

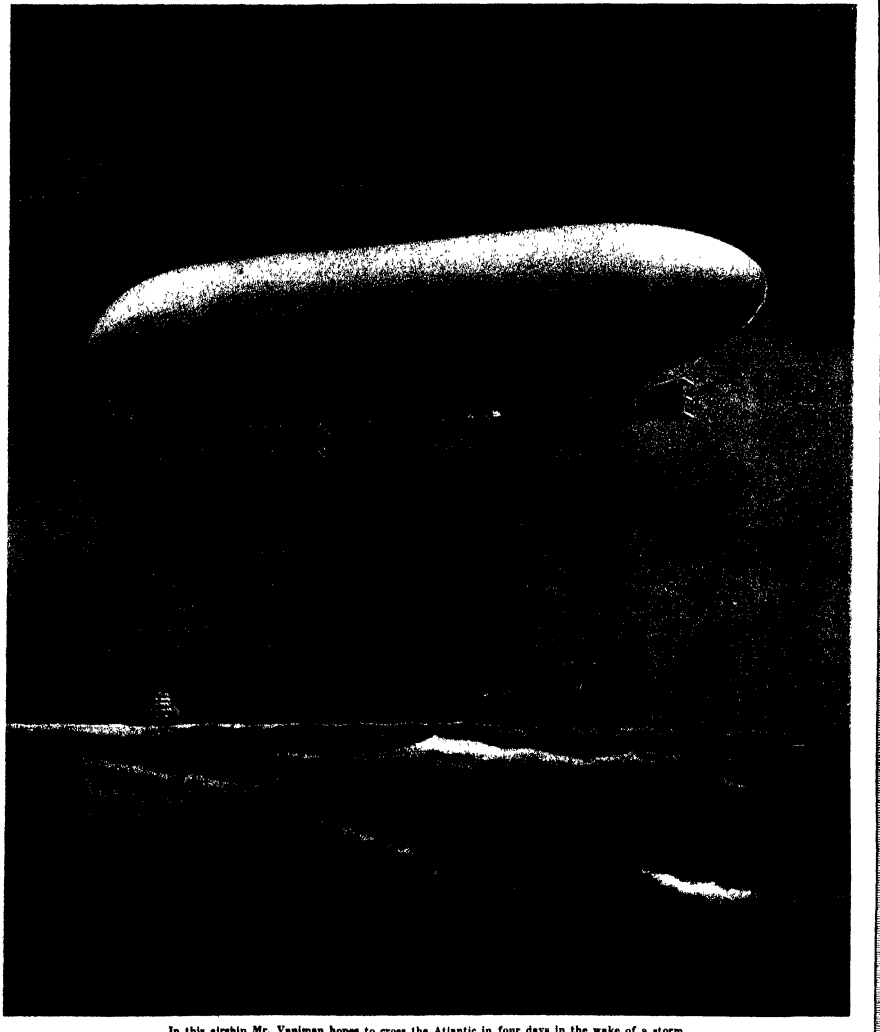
Change in the Habits of Wild Rabbits.—German natural historical periodicals are calling attention to an interesting change in the habits of wild rabbits, especially in the western parts of Germany, as for instance, Westfalen. The animals in question are giving up their ancient habit of burrowing, and have commenced in great part to imitate the hares, which, as is well known, nest only above ground. The hares themselves were once burrowers, and gradually went through the same change in habits in this particular that appears to characterize the rabbits at the present day—at any rate in Germany. In woods where the undergrowth is thick, and which are therefore especially suitable to the rabbits, they find hiding places in plenty for their nests; and even in open country, unwooded—and the rabbits seems to be taking more and more to the open—they take refuge in board-piles, rubbish-heaps, brush-piles, brick-kilns, drain-pipes, and ditches that are overgrown with weeds. The female makes little fortresses for her young, to protect them from the cannibalistic propensities of the male; she lines the nest warmly with fur from her own breast, visits them secretly at night, and perhaps suckles them once more during the 24 hours; but each time that she leaves them she carefully piles rubbish before the opening which leads to her defenseless family, and defies the obstructions with ordure.

SIXTY-SEVENTH YEAR

SCIENTIFIC AMERICAN

THE WEEKLY JOURNAL OF PRACTICAL INFORMATION

VOLUME CV. NUMBER 17.] NEW YORK, OCTOBER 21, 1911 [10 CENTS A COPY $3.00 A YEAR



In this airship Mr. Vaniman hopes to cross the Atlantic in four days in the wake of a storm.

VANIMAN-SEIBERLING TRANSATLANTIC EXPEDITION—[See page 366.]

SCIENTIFIC AMERICAN

Founded 1845

NEW YORK, SATURDAY, OCTOBER 21, 1911

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The purpose of this journal is to record accurately, simply, and interestingly, the world's progress in scientific knowledge and industrial achievement.

Popular Science

IT was Huxley, we believe, who expressed the opinion that it was the duty of every scientific man to scatter among the multitude a few grains of that scientific knowledge which he has laboriously acquired by patient research. Huxley himself practiced what he preached, for he gave the world the most ably-written popular scientific essays in the language, essays which stand to-day not simply as admirable examples of scientific reasoning, but as almost classical examples of good literary English. Indeed, the whole group of Darwinian disciples seems to have been gifted with the rare ability of presenting the facts of evolution, so that the mass could understand them, and doing so without loss of dignity. Perhaps it was because the acceptance of the theories of evolution conflicting though these did with the accepted theories of creation, had come rather from the people than from scientific men, that the popular writers on evolution directed their appeals to the men and women who had no scientific knowledge and who had to be talked to in their own language. Certain it is that "The Origin of Species" could hardly have been written more simply and more lucidly than it is.

That science, when it is popularly expressed, need not be sensational, need lose nothing in accuracy of statement, and may be even artistic in expression, is evidenced by the written work of Sir Oliver Lodge, Sir William Crookes and Sir Norman Lockyer. English men of science, on the whole, are better literary men than Americans. In this country we find, frequently, obscurity and carelessness of expression which can only be explained by the lack of that literary atmosphere with which the names of Cambridge and Oxford are inevitably associated. It may be that our violently sensational press which seizes upon the artificial germination of frogs' eggs and converts it into a double-page Sunday magazine "feature" that causes a real scientific man to writhe at its mere contemplation, has brought about this aloofness of the American scientist from popular science. In no country in the world is the thirst for knowledge so great as here. In no country are the people so willing to read articles on scientific subjects, if they are only expressed in an untechnical way. As we glance through even the popular scientific periodicals, we find them almost deliberately technical in expression. Sentences bristle with references to the "Huntingdon-Heberle process," the "Kerr effect," and the like. Engineers are particularly given to this method of expression, which, however intelligible it may be to the scientist interested in that particular branch of research, is cryptic to the ordinary reader. What can the man in the street be expected to know of the X-Y-Z-type motor, and such terms?

There can be no doubt that coupled with an actual thirst for knowledge is the appeal of the miraculous. Unfortunately, it is the miraculous only that is exploited in the daily newspaper and if the particular scientific discovery of the day is not sufficiently startling for journalistic purposes, the reporter will not hesitate to exaggerate, if it is merely for the purpose of astounding his readers. It cannot be denied that there is a romance in science, a poetic quality that can be legitimately expressed, and which is expressed by the best writers of the day. What, for example, can be more appealing than the thought of Caroline Herschel assisting her brother night after night in his astronomical work, even feeding him with her hands so that he might not be compelled to lose a single precious moment? What can be more dramatic than the fact that Newton, when at last he beheld the law of gravitation in his grasp, was unable to complete the simple calculation that inevitably proved the correctness of his views, so overpowering was the effect upon his imagination? What poet has ever soared to greater heights than Darwin and Spencer, men who reared upon the thousands of biological facts that picture of the evolution of all living matter that is epic in its magnitude? What can be more magical to the ordinary reader than the simple story of the coal tar dyes, that wonder working of the chemist which has converted what was once a noisome ooze of gas works, difficult to dispose of, into a palette of gorgeous colors, a medicine chest of precious healing unguents, an arsenal of explosives, a garden of roses? What man is so unemotional that he cannot be stirred by the recital of Edison's quest of a filament that would give him the light for which he was seeking, a quest during which men slept in his laboratory with resistance boxes for pillows and work benches for beds?

In a paper read last year before the section of Physiology and Experimental Medicine of the American Association for the Advancement of Science, Prof. Charles Sedgwick Minot speaks of technical articles which are "bungled in form and weakened by prolixity." It is his opinion that the heads of laboratories should insist, by example and precept, that all the workers under their influence, should write clearly and briefly. "For if an author fails to show respect for his own scientific work, how can he expect others to respect it?" Surely there can be no better way of intensifying the world's respect for science than by using the English language for the dissemination of knowledge in a dignified and yet simple way.

Popular scientific writing, in its best sense, by which is meant simplified and not sensational science, implies nothing that a really scientific man would not care to undertake. It is all a matter of expression, of writing down to the level of the multitude—not necessarily speaking the language of the street, but at least appealing to the brain of the street. It is writing such as this which has proved a source of inspiration to many a man who has later graced the laboratory and the observatory.

Aircraft in the Recent German Maneuvers

AS in France, so in Germany, aircraft have been employed in the army maneuvers this year for the first time in real earnest—not as an experiment, but as a legitimate branch of the regular service. This feature was emphasized even more in Germany than in France, because no civilian aviators in disguise were employed, but only the official military pilots, all officers trained at the military flying grounds in machines belonging to the army.

As it happened, these maneuvers demonstrated principally that, for military purposes, the shortcomings of to-day's aircraft count for less than elsewhere; for the weather was very propitious during the more important military operations. Aeronautics is evidently sufficiently revolutionary in warfare; this existence simply means that fair, quiet weather at any moment entirely reverses the situation as it may have developed while stormy winds prevailed.

In this year's maneuvers Count von der Golz, the Commander of the "blues," had at his disposal the older but entirely reconstructed Gross-Basenach airship "M II," and four biplanes, all of the German Albatross-Farman type. All these aircraft flew a blue-white flag, and the "M II," had a new envelope of silver-gray aluminium-rubber cloth, which, without being heavier, is much more gas-tight and weatherproof than ordinary yellow rubber cloth. The red army air squadron, at the disposal of Prince Friedrich Leopold, flew a white-red flag and consisted of the fast "M III." Gross-Basenach dirigible and four "Taube" monoplanes. The "M III" still had its old yellow envelope, which in the end caused its destruction by fire through its being an absolute non-conductor of electricity.

The homogeneous nature of each of the opposing airfleets also tends to give these German air maneuvers a more military and businesslike aspect than the French ones displayed. Each of the eight aeroplanes carried two men, a pilot and an observer, the very bird-like Etrich-Rumpler monoplanes being just as good passenger machines as biplanes. It will be seen that the red side had the faster craft. Each side organized an aeronautic field-park, consisting of one great "regulation" transportable airship tent (100 meters long), and four aeroplane tents. The former are very strong. They consist of a skeleton of steel masts and cables, covered with stout canvas. It takes twenty-four hours to pitch such a tent and half as long to break it up. The aeroplane tents could be pitched and struck in a very short time. They were transported, each on two automobile trucks. So it became possible that Lieut. Machenthun flew at dusk to the farmost line of outposts, and later, in the darkness, his tent was taken there too on its automobile train. He camped all night close to the enemy and at daybreak ascended and flew directly across the hostile position, while the automobiles "took flight" with the struck tent toward safety in the rear. Having but little distance to cover in reaching the enemy, Lieut. Machenthun thus, after very little time, was able to return with information of vital importance.

The most striking work of the aeroplane, however, was done on the red side. The military situation was such that the red army attacked at once in force, while the blue one was as yet scattered and showed a very weak front. An elaborate ruse was then resorted to, to "bluff" the reds. An officer of the general staff, pretending to carry a message on horseback to one of the blue commanders, allowed himself to be chased by red cavalry, and while in flight deliberately dropped a map with bogus positions showing great forces of the blues (who actually were still far away) marked upon it. The chart was recovered by the reds and in due course reached their commander-in-chief, who was much pleased with such a piece of booty, especially as cavalry scouts reported that the marked positions really existed. The reds were presently massed against empty ditches containing small heaps of stone and earth, which, from a distance, appeared to the scouting cavalry as the yellowish-gray, helmet-covers of infantry prone on the ground, while positions actually threatened were denuded of troops. To make doubly sure, Lieut. Canter's monoplane was sent flying over to the enemy's charted positions. His observer (long trained aboard captive balloons) had hardly passed the hostile advance posts, when he discovered the true nature of that first line of bogus positions. Instead of returning, the officers first continued their flight until they had found that the second line was a mask as well as the first, that the reserves were not where they had been marked on the captured chart, and that the only real strength at that front was strong bodies of artillery. But the time now had become pressing, and it was of the utmost importance that the red commander should be informed of his error at once. Lieut Canter did not have to fly far in a search for the red headquarters. He spied the black-and-yellow flag marking the position of the Emperor himself, and with quick decision he laid his course for it, came close to the ground and had his observer drop a card with the news right before the feet of the Emperor. The reds then won, and later, at the criticism that always follows operations, the Emperor asked for Lieut. Canter, shook his hand and thanked him personally. In his final criticism the Emperor dwelt especially on the excellent services rendered by the dirigibles and aeroplanes, which proved to be the decisive factor in these maneuvers. It was observed that the fast dirigible "M III." employed peculiar well developed tactics in dodging artillery fire by sudden changes in the level and direction of its flight. On both sides the dirigibles were in action all day long.

Horses Hold Their Own in France.

NOTWITHSTANDING the fact that the development of the automobile, as well as of the aeroplane, has proceeded more rapidly in France than in any other country, the use of horses seems to persist there better than in some of the slower-moving nations.

In ten years the number of horses in Paris has diminished by 24,210—that is, from 96,698 in 1901 to 72,488 in 1911. This large decrease (a trifle over 25 per cent) makes the increase for the country as a whole all the more striking. In Paris mechanical traction has displaced the horse on all the omnibus lines, and the horse-cab is rapidly disappearing.

The persistence of the horse in rural France is attributed to the fact that there, in contrast with England and Germany, for example, the land is divided into very small holdings, so that the farmers are for the most part quite unable to afford an investment in mechanical appliances for traction, etc., notwithstanding the greater eventual economy in using motors in place of horses. It is expected that the farmers' associations will be able to devise some co-operative plans that will give the small farmer access to the advantages of modern inventions along this line.

Frank Julian Sprague

Inventor and Engineer

By Thomas Commerford Martin

THE career of a great inventor and engineer like Frank J Sprague, graduate of the Naval Academy and successful pioneer in the modern art of electric traction, stands out with peculiar distinction There may be, or may have been, notable sons of Neptune in other fields, but in the electrical he has certainly few rivals from the sea; and in the department of electric traction none. This is hardly to be wondered at, for it is a curious twist of fortune that takes a man from the trackless deep and sets him laying track all over the face of every continent.

On May 16th, Mr Sprague received from the American Institute of Electrical Engineers the Edison gold medal—its second award—for his achievements in traction, horizontal and vertical, and in accepting this new and rare honor, he remarked that the reason why he won it was that Edison had refused to keep him as an assistant in the early days of electric lighting The picturesque details will be noted a little later The point to be made here is that the cause or reason is not carried back far enough to be altogether adequate The fact is that when Sprague left the navy, there was no navy to leave The result was a general exodus carrying into electricity such men who have made their mark in it as Sprague, Greene, Duncan, Weaver, Shallenberger, and many another Had they had the new ships to command they would all have stuck to the ship, Sprague included, and someone else among them would now be the rulers of Taft's navy There would have been plenty of room for all their electrical engineering in the application and use of the modern diversified electrical equipment The advocates of peace and of a small navy ought not to lose this opportunity of showing, as they can irrefutably, that the absence of a fleet was the main cause of giving the world its useful trolley system Another cause, going just a little farther back, was that Mr Sprague was born in Connecticut

Winning entrance to the Naval Academy in a competitive examination, and graduating in 1878, Mr Sprague was already electrical in his tastes and aptitudes Even then he was inventing, and made a special trip to show Edison a new wrinkle in telephony Menlo Park was doing quite a little business of its own in telephonic invention, the details of which when brought to Mr Sprague's notice convinced him that he would have to get up rather earlier to catch the worms Nothing daunted—for every aspiring youth in those days invented a telephone—he took up gladly the duties of his profession, and sailed for the Far East on the old U S S "Richmond." While serving on the Asiatic squadron he acted as the special correspondent of the Boston *Herald* in recording the travels of General Grant and the wonderful reception given the old soldier in the Orient. This was congenial occupation to a man gifted with unusual powers of observation and expression—but the note books not used up in this fashion were devoted to data of all kinds of electrical theory and invention. The present writer has seen some of them and realizes what a nuisance Sprague must have been to his messmates. It may have been due to their intervention that he was shifted to the training ship "Minnesota," where his didactic qualities had full play. His next appointments were to the navy yards of Brooklyn and Newport. Farmer, the electrician, was doing his notable work for the torpedo station at Newport, and no one could come within touch of that noble spirit without being stimulated to thought and invention

Mr Sprague was greatly impressed with the possibilities of electric lighting, and at a time when no naval ship anywhere had the incandescent lamp, proposed to get away from the old methods so disagreeable and dangerous. He asked Edison for the loan of one of those long-waisted "E" dynamos, prototype of the modern skyscraper, but when he said that it was to be hitched to an antique single-cylinder fly wheel pump, Edison demurred. The irregularity of the pump engine might have made Sprague the inventor of the Ardois signaling system, but Edison had an intense aversion to seeing his lamps flicker Sprague let himself loose on new arc lamps, continuous current machines without commutators, and a double wound armature with internal field, the several circuits being connected to a field to give various series and parallel combinations. He was slowly finding himself That there was real inventive ability developing in the man is evident from the fact that in 1881, watching the action of a large Ruhmkorff induction coil, he suggested connecting the high tension coil to a balloon and the ground, and in case of discharge to get larger currents of low potential from the primary without using the circuit breakers Had he been master enough of his technique to "follow through" Sprague could easily have hit then upon the transformer.

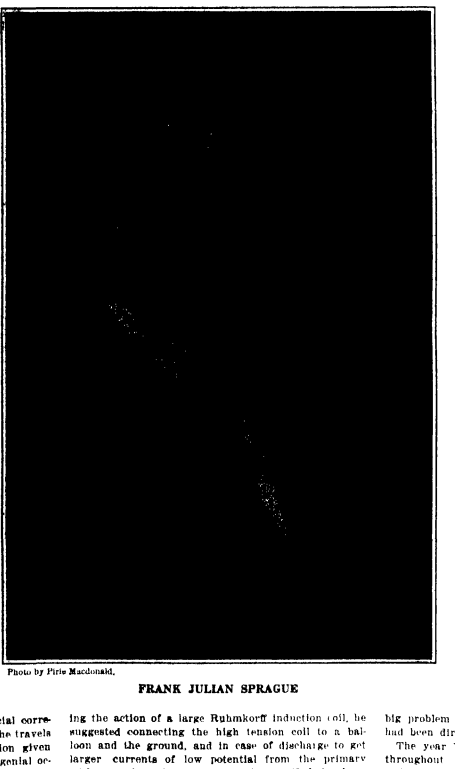


Photo by Pirie Macdonald.

FRANK JULIAN SPRAGUE

Then came the memorable Paris Electrical Exposition of 1881, and Sprague was crazy to get there He secured a detail to the U S S "Lancaster," bound for the Mediterranean as flagship, with leave at his own expense on his arrival abroad This in itself was an invention. The exhibition was closed, however, when the "Lancaster" passed the Pillars of Hercules; but as there was another electrical show in 1882, at the Crystal Palace, near London, young Sprague, by sheer nerve and audacity, got his leave extended, and landed in England with $20, an unnecessarily large sum for one so resourceful Taking up his work in connection with the exhibition—a landmark in English electrical history—he was made a member of the jury of awards, and at his own request was attached to the dynamo electric machinery section The section made him its secretary Here he was at once in his element meeting the great men of the day, revelling in the study of apparatus and free to ask any question that occurred to his preternaturally inquisitive mind In the midst of this delicious "joy ride," Sprague was peremptorily ordered to rejoin his ship at Naples, but though scared at the idea of a court martial, he bagged off, once more got leave, made a splendid report to the Navy Department on the exhibition and never went back That report is one of the very scarce electrical "treasure trove," and at once stamped Sprague as an engineer of quality In London Mr Sprague—barely an ensign yet- met Mr E M Johnson

'There is but one Edison and Johnson is his prophet,' said an English journal with equal truth and flippancy, and Johnson has always had a keen eye for talent He took kindly to young Sprague and sent him across the Atlantic to Edison just as he did that other distinguished leader, Samuel Insull This was May, 1883, and Sprague was ordered off to help in the construction at Sunbury, Pa., of the first overhead three-wire system of incandescent lighting That job was soon followed up by his being put in charge of the first three wire underground station at Brockton, Mass There Sprague made calculations for the distribution network of other Edison central stations then going on rapidly, but he regarded it as almost an impertinence to be bothered about them, for he was working out his first electric motor Here was the parting of the ways Edison has always wanted associates who were all his own, on whom his dominating personality could be impressed, who would help carry out his prolific ideas and not incidental inventions of theirs When Edison invited him to take up the subject of electric power transmission as an adjunct to Edison stations, Sprague replied airily and haughtily that he, too, had given a little thought to that, and meant to work it out from a personal point of view Needless to say, Sprague was invited promptly to resign With equal promptitude he did, organized his own motor company and in 1884 at the first American electrical exhibition in Philadelphia, made an enormous sensation by the exhibition of his new motors They not only gave a tremendous stimulus to central station development, as a source of supply of electrical energy, but set going a furore as to electric traction Sprague stationary motors for industrial power are in use to this day, but for the inventor the possibilities of the field were soon worked out, and he threw himself with redoubled energy on the big problem of transportation to which his thoughts had been directed ever since 1882

The year 1887 marks an epoch in electric traction throughout the world Sprague's first real street railway was that for St Joseph, Mo., but the vital point was reached when he took with confidence and even a light heart the contract to equip and operate a new system at Richmond, Va., with no fewer than forty cars All was crude but the goal had been reached, and with one great, mighty leap the trolley came into its own.

Meantime the Sprague interests had been consolidated into those of the Edison General Electric and the General Electric Company, with undoubted benefit to the public and the art, but leaving Sprague outside the breastworks They do say that his name was chipped off the castings The writer has never seen any evidence of such mutilation, but even if true it didn't make any difference; for Sprague was not chipped a bit On the contrary, he bobbed up serenely with a brand new system of electric elevators, and having tackled grades of 15 per cent blithely, now dealt deftly with those of 100 per cent Here Mr

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New York's Fire College

Fire-fighting and Rescue Work Reduced to a Science

By Herbert T. Wade

For many years the New York Fire Department has maintained a training school for firemen where practical instruction was given to those who had passed the civil service tests and had been appointed for a probationary period of one month. This training school not only was indispensable for the New York Fire Department, but served as a model for those of many other cities. To-day the need of thoroughly trained firemen is greater than ever, and their education can not be confined to such rudiments and essentials as may be taught to the probationer but in addition must involve systematic instruction all along the line up to and including the officers in command of companies and battalions.

In efforts made recently to raise even higher the standards of the New York Fire Department there has been established a Fire College which includes not only the various schools previously maintained by the department, but aims to extend and systematize the instruction in practical fire fighting, especially in the use of motor apparatus and other modern appliances now so extensively employed. This instruction is given by the best qualified men in the department and promotions to higher grades so far as is practicable are made only from those who have satisfactorily completed the appointed courses.

The chief of the department is the head of the Fire College Board, and the college itself is composed of a probationary firemen's school, engineers' school, officers' school, company school, and a special class in automobile operation. The first of these to be organized was the Probationary Firemen's School at which all the probationary firemen are required to attend for at least thirty days after their appointment and before they are regularly accepted and permanently detailed to companies. The instruction here as the illustrations show is exclusively practical, being based upon that formerly in vogue in the training school, but amplified as regards its amount and in the apparatus used. The practical work takes place in the rear of Fire Headquarters, where the probationers are marshaled with their scaling ladders of hardwood surmounted by a toothed hook and containing cross pieces up which a fireman may climb after the hook driven through a pane of glass perhaps is firmly placed on a window sill above. A number of scaling ladders in the hands of the firemen trained to their use affords a ready means of climbing up the side of a building and of passing from window to window. The probationers are taught not only the use of the scaling ladder, but to climb ladders of all forms used in fire fighting to raise and lower them, to straddle and stand on window sills, holding perhaps a companion in search of a point of vantage or passing along some inmate of the house who has been overcome by smoke.

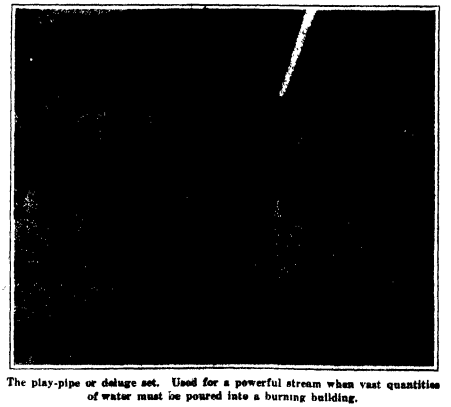
The large ladders, some of them 50 feet in length and carried on the hook and ladder trucks, also are used in the school, and the life saving rope which is shot up to the roof by means of a gun and shot line. The firemen are taught to haul up hose and ladders by a rope and to lower persons to points of safety when stairways and fire escapes are cut off by the flames or smoke. This means that the firemen must know the various knots employed and the method of using the gun. Then there is the use of the life net, for perhaps no one is left on the roof to lower the fireman and he must learn to jump properly into the net held by his comrades. They, too, must know how to hold the net properly. All of this involves careful training for the muscular men who already have passed a severe physical test, and day after day they raise ladders climb up and down them to the top of the six stories of Fire Headquarters until they become expert. Then also they must learn the use of the hooks and axes for getting directly at the seat of a fire and removing smoldering wood, the use of picks, battering rams, crowbars, mauls, door openers, lock openers, tin roof cutters, wire cutters, and pinch cutters, all to get into a building or directly at the flames, for a fire may occur at night when a building is tightly locked. Furthermore there are the ordinary connections of hose, to make them speedily is one of the first duties of the fireman, and he must understand the making of siamese connections, taking a line from engine or high pressure hydrant to a standpipe, carrying hose into buildings, and up ladders, connecting with a cellar pipe, and finally the use of hose within tall buildings where the building pumps or the city high pressure may force water far above the limits of the fire-engine in the street below. The high pressure now used in the lower parts of New York city presents many problems and dangers for the hosemen, and this is a modern feature which the new system of instruction aims to make clear. The construction and use of the large special hydrants and reducing valves is demonstrated and the method of connecting hose thereto and the use of the nozzle holder are explained. There is also instruction in the use of the fire alarm telegraph system so that various alarms, ambulance calls, and other signals can be sent, and finally the Fire Department surgeons give an elemental but practical course in first aid to the injured.



Teaching the firemen how to stretch and connect hose and the use of nozzle-holders with high-pressure streams. A three-way connection with cut-off valves is shown in the foreground.



Using the cellar pipe. The platform represents a ground floor through which a hole has been chopped in order to get at a cellar fire with a hose stream.



The play-pipe or deluge set. Used for a powerful stream when vast quantities of water must be poured into a burning building.

NEW YORK'S FIRE COLLEGE

Interesting and important as this work is, it is perhaps exceeded in actual usefulness so far as the New York Department is concerned by other schools for the engineers and higher officers. Thus in the past there has been criticism of the engineers of the fire department that in some cases they did not keep their engines at a high degree of efficiency, and in actual operation they did not get the results that a more intimate and intelligent knowledge of the machinery would have secured. Accordingly a few years ago an Engineers' School was started with beneficial results, and this was made a part of the Fire College with a more extended course and competent instructors. In the high pressure districts the engineer of a company is stationed at the hydrant watching the control and reducing valves, while with the extensive introduction of motor apparatus now in progress he will be concerned with the care and operation of the gasoline engines. In the first place all engineers are required to attend this school, which is open also to first and second grade firemen upon approved application.

Hereafter only graduates of the school will be appointed as engineers. The practical work is being done in one of the machine shops of the department and consists of an extended course in engines and boilers and gasoline motor engineering. Here the engineers and firemen desirous of promotion study the actual machines and their construction and operation.

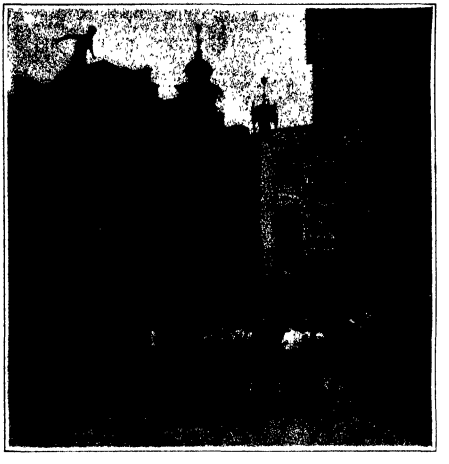
For many of the engineers, not to mention the firemen, gasoline motors have been a sealed book, but under the administration of Commissioner Johnson much motor apparatus is being added to the New York Fire Department and eventually the entire department will be on a motor basis, so the importance of the work is evident. In fact so immediate is the demand for properly qualified chauffeurs belonging to the uniformed force and men competent to operate and repair gasoline

engines, that there has been established a special class at the repair shops of the department for the training of such firemen. Here the men are taught the practical operation of motor apparatus so that competent chauffeurs will be forthcoming as the horse-drawn apparatus is displaced. This is taking place as rapidly as possible, and by the end of the year the New York Fire Department will have a number of distinct and separate types of motor-drawn machines in use.

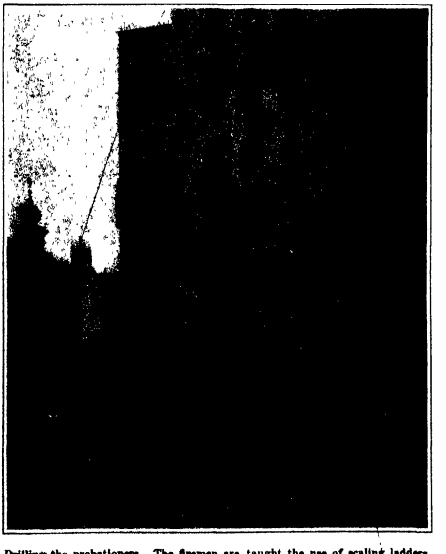
The Officers' School affords a means of raising the general technical standard by having those who have evolved certain practical methods teach them to others, and give general information as to conditions and methods in different parts of the city. Thus chiefs and company commanders in the high pressure districts have learned to use this new weapon most effectively and gradually are standardizing the different practices. These must be taught not only to those serving in the protected territory but to others who may be called there either individually or with their companies in the event of a large fire. In other words, certain chiefs and firemen have acquired special skill in dealing with certain conditions, and it is the intention that such methods should be taught to every officer.

For the company school entire companies are ordered to Fire Headquarters and are instructed and drilled in the effective use of the apparatus.

The entire Fire College is intensely practical in its spirit, and its object of raising the general standard of fire work in New York city doubtless will be attained. With the practical work thus brought up to an even higher degree of excellence, it is likely that problems of construction and engineering eventually will be undertaken and the technical and professional knowledge of the firemen be correspondingly broadened, but to-day it is realized that efficiency alone is the keynote and this can be realized only through training and discipline.



The life net. Firemen being trained to jump into a net held by their comrades.



Drilling the probationers. The firemen are taught the use of scaling ladders and ropes for life-saving. The life gun and shot line to haul up a rope is the last chance for a fireman cut off by flames or smoke.

NEW YORK'S FIRE COLLEGE

Wireless Detectors

By Adelbert J. Gogel

ELECTRIC wave detectors, the most delicate part of the wireless receiving set, are the subject of much argument as to their relative sensitiveness and relative merits. There are a number of different types known, which may be arranged as follows in order of merit, according to most authorities:

(1) Electrolytic, (2) Peroxide of Lead, (3) Perikon (Chalco-pyrites and zincite), (4) Ferron (Iron pyrites), (5) Silicon, (6) Molybdenite (Molybdenum Disulphide), (7) Galena (Lead Sulphide), (8) Carborundum (Artificial Silicon Carbide).

The Electrolytic Detector, perhaps the most widely known type, appears in many forms, the most frequently used of which is that in which the point of a very fine silver plated platinum wire, about 0.001 millimeter in diameter, called a Wollaston wire, is immersed in a nitric acid solution contained in a small graphite-carbon cup. It is necessary to use a battery and a non inductive rheostat capable of very fine adjustment, called a potentiometer, in connection with this detector. The battery polarizes the electrolytic cell, that is, the fine platinum wire is covered with tiny bubbles of oxygen and then the resistance rises so high that the current is nearly reduced to zero. If then an electric wave fall on the aerial connected to the electrolytic detector, it suddenly reduces the resistance of the cell. A telephone receiver of great sensitiveness being connected in series with the cell and potentiometer, sound signals can be heard in the telephone. For general and long distance work, this detector cannot be excelled except in localities where high powered interference is very frequent, which causes the platinum wire to be dissolved very rapidly and a detector working on different principles must be substituted. Substitutes will be mentioned later. The Lead Peroxide Detector consists essentially of a pellet of lead peroxide clamped between two surfaces, one of lead and one of platinum. A battery, potentiometer and telephone receiver are connected with the detector in the same manner as with the electrolytic detector. The lead peroxide detector works on a new principle, although no acids or liquids of any kind are employed its action is electrolytic. When lead peroxide, lead and platinum are brought in contact as described it has long been known that lead will be deposited on the platinum surface. When a battery is connected up properly with the detector, it opposes this action and causes the lead to be deposited upon the lead surface. When an electric wave falls upon the wires connected with the detector, a sound in the telephone is heard because of the change of resistance brought about by the passing of a wave. The Perikon Detector contact is between crystals of chalco pyrites and zincite, in the Ferron Detector between a crystal of iron pyrites and a metal point, in the Silicon Detector between the element silicon and a wire, in the Molybdenite Detector between a crystal of molybdenum disulphide and a metallic surface, in the Galena detector between a crystal of lead sulphide and a very fine wire, in the Carborundum Detector between a crystal of carborundum or silicon carbide and a metallic surface.

The Silicon Detector retains its adjustment even when very near to a very high powered sending apparatus, and is therefore to be recommended where interference is very severe. If a piece of 99/100 per cent pure silicon can be procured, nothing better can be desired.

The Carborundum Detector, even though subjected to somewhat severe blows, often retains its adjustment for months at a time, which causes it to be the favorite detector with the amateur. However, it requires the use of a battery and potentiometer for its efficient use in long distance work. The green crystals are more sensitive than the blue or purple ones. The side of the crystal connected to the ground should be covered with tin foil or soldered in a cup.

A New York firm has put on the market a promising new detector for which broad claims are made. This detector is of the vacuum bulb type and very similar to the "Audion" of Dr. Lee De Forest which is not within the reach of the average experimentalist owing to its high cost. This detector consists of an electric light filament, a grid and a plate sealed in a highly exhausted bulb. A battery to light the filament and another battery and a rheostat capable of very fine adjustment are necessary for the operation of this detector. When the current to light the filament is turned on the detector is ready for business, requiring no adjustments of crystals and points or Wollaston wire and acid. This detector can be used to receive from all systems of transmission, singing spark quenched spark, arc sets, telephone sets in fact it will detect any wireless wave from whatever source it is produced. The makers of this detector claim it to be more sensitive than the electrolytic which will be a decided advance in wireless receiving apparatus.

The wireless operator should not content himself with one detector but should have several ready for use and a switch with which to connect up the desired one.

A device of some kind should be used to ascertain whether or not the detector of a wireless set is in a receptive condition. Several devices of this class are quite well known but a short description will not be amiss. If a key sounder and battery are connected up near the detector a sound is heard in the detector when the key is raised, if the detector is in working order. This method requires the constant operation of the key during the test or search for a sensitive area. But the author has found that if an ordinary electric bell with the gong removed or a buzzer, is connected with a switch and battery, and two or three feet of copper wire be connected to the interpreter, the arrangement is much more convenient and efficient. The short length of wire acts as an antenna, and owing to the speed of the vibrator, a continuous musical note is heard in the receiver when the detector is working properly.

A variable condenser of good capacity should be shunted around the detector enabling weak signals to be strengthened or cut out as desired. While transmitting, the detector should be short circuited by a switch to prevent its being burned out, or the wire in the telephone fused.

When not in use, the detector should be protected from dust and moisture. The crystals of the thermo-electric type of detector should be touched with the hands as little as possible for the oil secreted from the skin causes a marked decrease in the sensitiveness.

Vaniman-Seiberling Transatlantic Expedition

Preparing for the Second Attempt to Cross the Ocean by Airship

It was with no feeling of regret that Mr Melvin Vaniman, leaning over the taffrail of the steamship Trent watched the ill fated airship "America" sink slowly to the sea One might suppose that the engineer who had spent so many years of work on this dirigible would entertain some sentimental regard for the old balloon But Mr Vaniman's thoughts were on another expedition, in which he would not be hampered with old material, an old gas bag, and old engines, but could plan an entirely new airship made of brand new material exactly as he wanted it The "America" had served her purpose well, and from her in the years that had passed Mr Vaniman had learned the lessons that were necessary to make a future ship successful The design of this new airship was already beginning to take form in his mind, and after a short rest he was eager to begin the work again along new lines

When the "America" was abandoned it was structurally sound showing that the principles involved were correct One part only had failed, a key worked loose in one of the propellers, and to this defect Mr Vaniman attributed the failure of the expedition, as was pointed out in the SCIENTIFIC AMERICAN of October 28th, 1910 The propeller was one of a pair that could be revolved with their axes so as to exert a thrust at any desired angle Had he been able to use this pair of propellers to lift the machine bodily upward by power, he could have raised his equilibrator out of the water and prevented that terrifying and nerve-racking surging of the airship caused by the drag of the equilibrator in the waves during the storm Contrary to public opinion, Mr Vaniman's faith in the equilibrator, or its equivalent, was not shaken, of enabling the "America" to beat all records for dirigible balloons as to time in the air, distance traveled and weight carried Its action in the sea, its defects and good qualities were all known after this voyage, and it was from this experience that Mr Vaniman got to the heart of the problem, viz, the designing of a device that would serve the purpose of the old equilibrator and not have its defects, a device that would have a changeable weight not a fixed weight, in other words an equilibrator that could be made heavy or light at will

Principal Features of the Construction.

Early this summer Mr Vaniman succeeded in interesting Mr H A Seiberling, president of the Goodyear Tire & Rubber Co., of Akron, Ohio who agreed to furnish the necessary capital The construction of the gas bag was immediately started at the Goodyear plant and it was shipped to Atlantic City early in September The gas bag was built according to Mr Vaniman's directions and differs considerably from that of the "America" The "Akron," as the new airship is called, is longer but of smaller diameter, and tapers gracefully toward the stern The old hangar of the last year's expedition is being used by Mr Vaniman, and to use this shed without enlargement it was found necessary to cut out 10 feet from the envelope as originally designed The present length of the gas bag therefore, is two hundred and fifty-eight feet, while its diameter is forty-seven feet

Below the airship runs a car similar in shape to that of the "America," but, in the present instance, considerably longer The body of the car is a steel tank forming a reservoir for five tons of gasoline On this tank a platform is built, which is the deck of the airship To drive the airship three engines are provided One forward, of 100 horse-power rating, is fitted with propellers that rotate only in the vertical plane The next two engines, of 100 and 80 horse-power, respectively, drive the propellers whose plane of rotation may be turned to any desired angle Normally, only the forward engine will be used to drive the airship ahead, and it should give the craft a speed of about 30 miles per hour About 60 pounds of gasoline will be consumed per hour, so that the supply of gasoline should last about a week The propellers of the other two engines will be feathered, or turned to horizontal position, so as to offer no resistance to the forward propulsion of the vessel In addition to these engines, there is a 17 horse-power engine directly connected with a dynamo, which will generate current for lighting the airship at night and for operating the Marconi wireless telegraph apparatus. This engine will also operate a blower with which the ballonets of the gas bag may be filled Furthermore, it will drive a pump countershaft with which any one of the large engines may be started

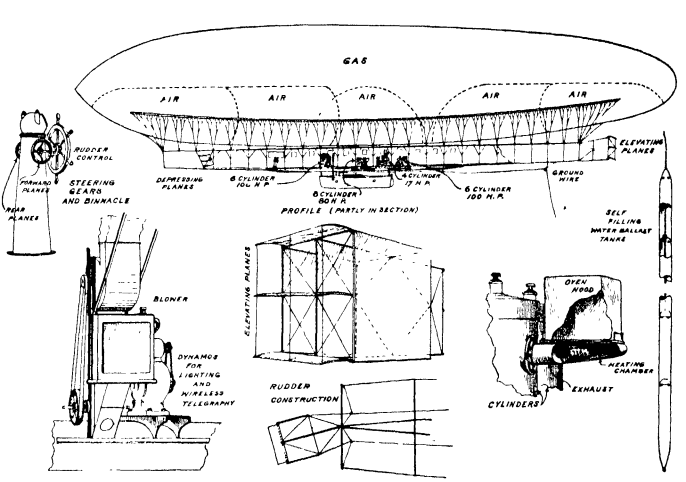
Substitute for the Equilibrator.

"If we can only keep down," said Mr Vaniman in a recent interview, "our problem will be solved" It is an easy matter to design an airship to lift the necessary weight to enable one to cross the Atlantic The difficulty is to maintain the airship at a constant moderate elevation above the water The equilibrator performed this office last year This year Mr Vaniman expects to control the height of the airship mainly by taking on water ballast, and also by using stabilizing planes fore and aft In case of emergency the elevating and depressing engines can be used. There will be three planes on each side of the car, at the forward end, which, as indicated in our front page illustration and also in the accompanying sketch, are curved upward, while those at the rear, mounted on the rudder, are reversely curved These planes may be tilted to any angle desired, and will serve to keep the car on an even keel When dipping down to take up water ballast, the forward planes will be used for depressing the bow and the rear planes for elevating the stern These planes may be controlled separately by handwheels at each side of the binnacle, as indicated in one of the sketches The level of the vessel may also be controlled to a considerable extent by inflating the ballonets forward at the expense of those to the rear, when it is desired to make the bow heavier than the stern, and *vice versa*, when it is desired to make the stern heavier

To scoop up water ballast, it will be necessary to drive the balloon down near the level of the sea, which may be done by tilting either pair of the adjustable propellers to the proper angle. The only object in having two sets of adjustable propellers is to have a reserve pair in case of accident. The device with which the water ballast will be taken up is similar to the equilibrator used last year. It consists of tanks about 6 inches in diameter and 24 inches long, strung upon cables exactly as were the gasoline tanks of the equilibrator These water ballast tanks will be provided with openings near the upper end of each, so that by dragging them in the sea they may scoop up water There will be three sets of tanks strung on separate cables, and under normal conditions they will not hang from the car, as did the equilibrator, but will be stored in the body of the vessel.

When taking up the water for ballast, if the wind is strong, the airship will be headed into the wind and the tanks will be trailed from a point aft of amidships, so that there will be no tendency for the airship to nose downward into the sea

It is planned to maintain the airship at an elevation of between 200 and 1,000 feet at the outset of the voyage, but as the airship is lightened by the consumption of gasoline and the provisions, the airship may rise to much greater heights During the daytime it will have to be heavily water-ballasted in order to hold it down when the gas in the balloon is expanded by the heat of the sun At night this ballast will be poured out to compensate for the contraction and consequent reduced lifting capacity of the balloon



Some novel details of the airship with which the transatlantic voyage will be attempted.

Suspended below the car will be the lifeboat in which the crew of the "America" made their escape This will be materially changed to facilitate launching and for the comfort of the crew There will be no well in the center, because there will be no equilibrator to pass down through it In this boat the wireless telegraph apparatus will be stored A much more powerful equipment will be provided this year, with a range of 500 miles, so that there will be little difficulty in keeping in touch with vessels along the course To provide a ground, a wire will extend to the stern of the vessel, and thence trail in the sea, as indicated in the front page illustration.

The Crew.

The crew of this expedition will consist of the commander, navigator and helmsman, a wireless operator, two engineers to keep constant watch over the engines, and one extra man for general work.

Provisions will be carried for a cruise of twenty days. An ingenious cooking stove has been provided. Last year, when at the close of the first day it began to grow dark, Mr Vaniman was astonished to find that the exhaust pipe of his engine was red hot and expelling streams of sparks that were invisible by day This year he has made a cook-stove on the exhaust, as shown in one of the sketches, and will utilize the heat for cooking

On the Wings of a Storm.

The construction of the airship is proceeding very rapidly and will probably be completed by the end of this month Thereafter, two or three trial trips will be made, and then, when weather conditions are favorable, the expedition will be launched. Mr. Vaniman expects to make good use of the storms that travel across the Atlantic to carry him over. It will be recalled that last year a storm was encountered which carried the airship along at such speed that

it had to drift broadside to the wind, owing to the drag of the equilibrator. This storm with the aid of the motors took the airship to a point near Nova Scotia, but then vanished, and a second storm which had been forming over Cuban waters for three days began to affect the airship, although 1,200 miles away The wind flowing toward the storm center was so strong that the motors could not be used, and the airship was taken southward out of its course. Had the "America" been able to lift its equilibrator and scud before the wind, it would have been carried more than half-way across the Atlantic inside of two days by the first storm; for the meteorological charts show that this storm traveled to within a few hundred miles of the other side before it was spent. As a rule, it takes from three to four days for a storm to cross from the western to the eastern shores of the Atlantic Ocean As is well known, the winds of a storm always blow toward the storm center. As a storm center moves up our coast, the winds blow toward it from the northeast, but when it passes beyond us out to sea, it is followed by westerly winds It is Mr. Vanlman's plan to start after a storm center has passed from 800 to 1,500 miles out to sea Then on the wings of a western wind, he will be carried toward this center, which, in the meantime, will be moving rapidly across the ocean. By driving his airship at the rate of 20 miles an hour, he will succeed in moving faster than the storm center, and he confidently expects to be able to cross the Atlantic, under such conditions, in less than four days

Navigating Instruments.

In connection with the airship expedition, Mr Vanlman has devised a number of interesting instruments which will indicate the direction of his travel and also his speed One of these consists of a combined camera and compass, the camera having its field divided into squares Noting how long a fixed object on the water below takes to pass across a given number of squares and knowing his height above the water, as indicated in the barometer, he will be able to determine definitely his speed over the water, and, by referring to the compass, his direction of travel The only fixed objects on the ocean are the white caps It will be recalled that, although waves travel, the water that forms them is practically stationary Hence the foam of a white cap may be considered a fixed object on which observations may be made In addition to this, Mr Vanlman has invented a sextant of an interesting type, for use on the expedition

Despite the sensational nature of the expedition, Mr Vanlman cannot be considered a mere adventurer He is intensely interested in mechanics and invention and in no other field does he consider that there are such possibilities as in the future dreadnought of the air the dirigible balloon

Electricity

Experiment in Purchasing Electricity.—The work of electrifying the lines from Lauban to Konigszelt is soon to be begun. The current for these lines will be bought from commercial electric power stations, instead of being supplied by a power station built by the railroad itself. The decision to purchase power was made in order to determine whether this would be a cheaper way of operating the line than if the power were generated by a station built especially for the railroad.

Telephone Precautions in Gas Works.—An investigation was recently made in Germany to determine whether any accidents had ever occurred in gas works by the ignition of gas with sparks from the telephone apparatus. No such accidents were reported, although it was found that gas could be ignited if it were projected upon the instruments while they were in operation Hence the Association of German Gas and Water Works has decided to permit the use of telephones in gas works, but requires that they be protected The bells, for instance, should be covered with a wire gauze guard

Restoring Sulphated Cells.—A method of restoring sulphated storage cells was recently described in the *Journal of Physical Chemistry* It is recommended that the cell be restored by charging it at the usual rate in a solution of sodium sulphate The sodium sulphate should be pure, and the best concentration is found to be 200 grammes $Na_2SO_4 10H_2O$ per liter A 60 hours' charge should be sufficient to restore the cell The cost would be exceedingly small as compared with the method now sometimes used, of charging the cell at half the normal rate for a long time in the ordinary battery acid

Cactus Telephone Poles.—According to a recent press report, the government is about to build a telephone from Tucson, Arizona, into the Catalinas, for the forestry service The building of the line will be rather difficult, owing to the rocky nature of the country, which will make it impossible in some places to set wooden poles of the ordinary type It has been proposed that in the canyons the cacti growing along the line be used. Brackets will be fastened to the cacti, and the wires will be supported on the brackets in the usual way. This type of pole may be adopted wherever cactus grows along the line, provided it does not require too much zigzagging

The Boston Electrical Show of 1912.—Plans are under way to make the electric show in Boston, from September 28th to October 26th, 1912, the largest electrical exposition ever held in the world The entire Mechanics Building in Boston will be used This building has 105,000 square feet of exhibit space, not counting the halls and aisles, and a seating capacity for over one hundred thousand visitors at one time It is hoped that this electric show will afford an impressive demonstration of the possibilities of electric development, particularly in New England There seems to be a wide-spread electric awakening in New England, which is extending beyond the cities to the rural districts as well.

Electric Cranking for Automobiles.—One of the prominent automobiles for 1912 will be equipped with a generator and storage battery normally used for lighting the lamps and igniting the engine, but with the generator so arranged that it may also be used as a motor to "turn over" the engine, thus obviating the necessity of cranking by hand. When the operator pushes the clutch pedal, a gear wheel on the electric motor will engage with teeth on the fly wheel, and the motor will be operated by current from the storage battery, to turn the fly wheel and start the engine When the engine starts the motor becomes a dynamo, and generates current to be used for charging the storage battery, and for ignition purposes.

Science

The University of the Philippines.—According to the *Manila Free Press* it is expected that Vice-Governor Gilbert will select several new members of the faculty of the University of the Philippines during his visit to the United States Physics apparatus to the amount of $2,500 has recently been purchased Several hundred students are now in attendance

Standard Time in Portugal and Her Colonies. Following the good example recently set by France, Portugal and all the Portuguese colonies will adopt standard time, in accordance with the recommendations of the Washington Meridian Conference of 1884 The change takes effect January 1st, 1912 Western European time (I e, Greenwich time) will be used in Portugal, the Islands of Principe and Sao Thomé, and Whydah

A Double Shooting Star.—The rare (if not unprecedented) observation of a double shooting star was made by the Abbé Verschaffel, director of the observatory at Abbadia, at Hendaye, France, at 3 17 A M July 22nd, according to a note published in *L Astronomie* The larger of the two components was eight or ten times as bright as Venus, and left a slight trail, it was followed at a distance of about four degrees by its companion, which was as bright as Venus Both objects were white They moved rather slowly from west to east

Prof. Schuster to Lecture at Johns Hopkins —A course of lectures will be given between October 16th and 28th in the physical laboratory of Johns Hopkins University, Baltimore, by Arthur Schuster, F R S, honorary professor of physics in the University of Manchester Prof. Schuster will discuss the cosmical applications of recent advances in physics explaining the methods of examining correlations between solar and terrestrial phenomena, and pointing out the problems in solar and terrestrial physics that seem to call for special investigation Meteorologists and climatologists will be interested to know that the lecturer proposes to disprove the existence of Ed Brückner's 35-year meteorological cycle

A Martyr to the X-Ray.—Dr Hall-Edwards, of the Birmingham University, according to the *English Mechanic and World of Science*, has not been spared the payment of a heavy price for the benefits he has conferred on mankind by his researches in X-ray photography A short time ago both his arms were amputated as a consequence of the dangerous experiments he had carried out He has just made the novel suggestion that photography should be included in the ordinary university course of training The connection between photography and art, he thinks has been overrated Nothing has helped science more than photography of late years, and it should, therefore, receive more attention than it does at present in the education given both in schools and in the universities.

The Telephone and the Phonograph.—A reproach which has often been raised against the telephone is that it leaves no trace whatever of the conversation transmitted. Thus, a telephone conversation can never figure in a law suit. It is not surprising, therefore, that for some time past efforts have been made to devise an apparatus by means of which a permanent record can be kept of the words spoken over the telephone, and the phonograph has often been thought of in this connection. According to a note reproduced in *La Nature* from *L'Elettricista*, Prof P Perotti has just scored a success in this direction The telephone receiver is composed of two loud-speaking telephones, one of these is furnished with the usual mouth-piece; the other is connected with the vibrating membrane of a Pathé phonograph The current required for this telephone is a little greater than for ordinary installations. The phonograph record can be made to reproduce the speech in the usual manner.

Engineering

A Tunnel Under the Yangtze.—It is stated, on the authority of the *London and China Telegraph*, that a report has been made to the viceroy of Kiangsu on the much-talked-of project of a bridge over the Yangtze River The report is said to be adverse to this project and to advocate a tunnel, as more practicable and much less expensive

A Year's Progress at Panama.—The total amount of excavation in the Atlantic, Central, and Pacific divisions during the fiscal year 1910-11 was 31,804,120 cubic yards There were excavated in the Atlantic Division 6,738,548 cubic yards. The total excavation in the Central Division was 18,522,692 cubic yards, of which 16,221,672 cubic yards were removed from the Culebra section, locally known as Culebra Cut, and the remainder—2,301,020 cubic yards—from the Chagres River section Excavation in the Pacific Division aggregated 6,542,915 cubic yards

Photographic Views of the "Liberté."—The photographs of the wreck of the "Liberté" show how similar were the effects of the explosion of her magazines to those observed on the "Maine" This is not surprising In both cases the energy of a large amount of explosives was suddenly developed at a point many feet below the surface of the water The resulting gases unable to escape through the bottom or sides of the ship being resisted by the incompressible water, expended their energy in tearing apart the decks above and folding them back, forward upon the bow, and to the rear upon the superstructure

The Latest Atlantic Liner —Not a great many years ago the new Anchor liner "Caledonia" the latest addition to the fleet of large passenger ships on the Atlantic would have been hailed as the largest ship afloat, but so rapid is the increase in length and size that a handsome ship of this class will slip into a port like New York on her maiden voyage with scarcely more than a passing notice She is 570 feet in length and at full load displaces 17,000 tons Built at the yards of D & W Henderson & Co., Ltd., she is not only the largest vessel launched from that yard but is the most up-to-date vessel possessed by the Anchor Line

Widening the Corinth Canal —The canal which cuts the Isthmus of Corinth was opened in 1893, its route being the same as that over which the Romans tried unsuccessfully to construct a canal in the time of Nero Although it shortens the journey from the Adriatic to the Piraeus by 202 miles this canal has been little used by foreign steamships, on account of its narrowness and the strong current which makes the passage dangerous and it has hardly been successful as a financial enterprise Operations have now been begun, however to widen the canal, so as to make it navigable for vessels of the largest size The cost of the improvements is estimated at $160,000

Advantages of Internal Gear Drive—The advantages of gears over chains as a motor-truck drive may be enumerated as follows The gears can be properly inclosed and lubricated and any range of reduction obtained The differential can be run at a higher speed and hence at less strain and higher efficiency than chains The bevel gear reduction can be made one to two while with the chain the bevel reduction is found to be in general one to three and one to four The former, therefore, is a more efficient bevel gear because the efficiency of the bevel gear decreases when the ratio of reduction increases The side swaying of cars causes chains to get out of line and thus increases wear The stretch of the chain must be taken care of from time to time by readjustment of the radius rods Both radius rods must be given uniform readjustment or the rear wheels will not run in line Few laymen can do this Bevel gears are at all times in positive relation to one another and do not require readjustment.

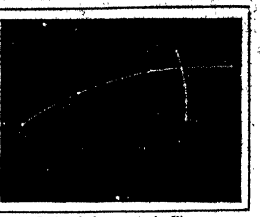


Diagram of Brooks's comet.

Three Comets Now Visible

Directions How to Find Them

By Prof. S. A. Mitchell, Columbia University



Path of the comets in Virgo.

TWO comets are now visible to the naked eye one in the evening and one in the morning sky, and a third one may be seen with an opera glass or small telescope if one cares to look for it

The year 1911 has been rather remarkable in that no less than seven comets were discovered in the nine months before the end of September The sixth comet for the year known in astronomical circles as comet *f* 1911, was discovered abroad on the evening of September 22rd, by Quenisset while the seventh comet or comet *g* 1911 was picked up on the morning of September 29th by Beljgawsky, making it the first comet ever discovered in Russia

For a few days after the discovery it appeared as if Beljgawsky's comet were going to fulfill the wish for a brilliant comet expressed by the writer in SCIENTIFIC AMERICAN September 30th page 299 On September 30th, the morning after its discovery on a rather bright sky due to the coming of dawn, Prof Frost at the Yerkes Observatory saw the comet's nucleus as bright as Regulus the chief star in the "Sickle," with a tail 5 or 6 degrees in length Under slightly more favorable circumstances, the comet would probably have been as bright as Halley's, when this interesting visitor was present in the morning skies

Unfortunately however, the comet did not live up to expectations so that now we have not a comet in the sky so brilliant that all may see it without the aid of special directions

When a comet is discovered it is necessary to calculate its orbit and predict where it will be in future by the aid of an "ephemeris" As mentioned in the article on Brooks's comet (SCIENTIFIC AMERICAN September 30th) most of the orbits are computed on the assumption that the comet is moving in a parabola about the sun The position of the comet in space at any time depends on five quantities which are called the *elements* of the orbit The plane of the comet's orbit in space is defined by its relation with respect to the ecliptic, and it takes two quantities to express this One of these quantities is the line in which the comet's plane and that of the earth, or ecliptic intersect This is called the *line of nodes* The other is the angle between the two planes, or *inclination* When the comet crosses the ecliptic, passing from the south to the north side, it is said to be at the ascending *node* (symbol, ☊) To determine the direction of this line in space we need the longitude of the ascending node, which is the angle in the plane of the ecliptic from the vernal equinox to the ascending node

The third element needed is the direction of perihelion in the plane of the orbit This is called the *longitude of perihelion* and is the angle in the plane of the orbit from the ascending node to the perihelion point The fourth element is the distance of the comet from the sun when at perihelion, and the fifth the time at which the comet is close to the sun

Each observation of a comet's position gives two coordinates right ascension and declination, and hence to determine the five elements three complete observations are necessary Obviously it would be exceedingly difficult to tell the exact curve in which the comet is moving from a very small section of its orbit and when it is remembered that the center of a comet has nothing well defined about it and is difficult to measure it is not surprising that two preliminary orbits calculated by different persons from different observations perhaps, will disagree quite a little

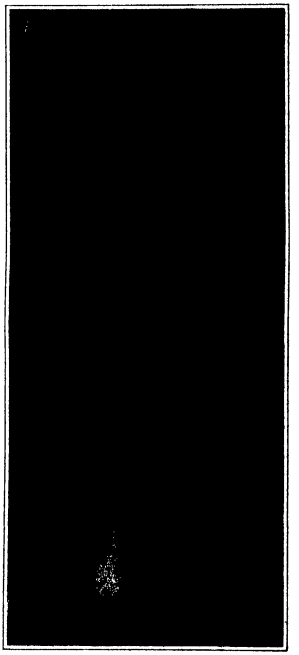
After the elements are known it is possible to calculate the right ascension and declination which the comet will have at dates in the future A comparison of the calculated places and those observed will give a means of estimating the accuracy of the cometary orbit

Ordinarily the three observations used by the calculator for the comet's elements are those first published, which generally come on successive nights

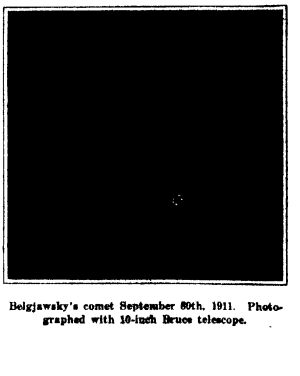
A cablegram from Prof Kobold of Kiel, Germany, to Prof Pickering of Harvard College and by the latter distributed to American astronomers, gave the information that Kobold had computed an ephemeris for Beljgawsky's comet from observations made September 30th, October 1st and 3rd The elements were

Time of perihelion passage T = 1911 Oct 10. d 26 G M T.

Perihelion minus node	ω = 71 deg 39 min
Longitude of node	Ω = 88 deg 44 min
Inclination	i = 96 deg 38 min.
Perihelion distance	q = 0.0304



Brooks's comet September 22nd, 1911. Photographed with 10-inch Bruce telescope.



Beljgawsky's comet September 30th, 1911. Photographed with 10-inch Bruce telescope.

The ephemeris for Greenwich midnight follows

		RIGHT ASCENSION	DECLINATION.
1911	Oct 5	12 hrs 1 min 39 sec.	+12 deg. 11 min.
	9	12 hrs 57 min 53 sec	11 deg. 38 min.
	13	13 hrs. 50 min 4 sec	7 deg 45 min.
	17	14 hrs 30 min. 30 sec.	2 deg 16 min

A glance at the above elements at once showed to the expert astronomer that this was a most unusual comet Here was a comet moving almost at right angles to the plane of the ecliptic, and remarkable for that reason The unit for measuring distances to comets is the distance from the earth to sun, and here was a comet coming within 3,000,000 miles of the sun This insured that the comet would be a brilliant one, but the perihelion passage occurring on October 10th told that the comet would soon dwindle in brilliancy The right ascensions and declinations of the comet showed that it was moving south and east and since the comet was visible before sunrise, this meant that it would become invisible in the glare of the sun, to be seen later in the west after sunset On October 17th, Beljgawsky's comet set at 7 o'clock, and may be now seen shortly after sunset at the position given on the diagram above. The comet is now but a shadow of its former self.

The photograph shown is one by Prof Barnard on September 30th at 4 34 A. M with an exposure of only five minutes The tail was 5 or 6 degrees long to the naked eye, but the exposure had to be cut short on account of the approaching dawn On October 4th, another photograph by Prof Barnard shows a tail of about 8 degrees, slightly curved The convex side was toward the north with a streamer extending southward at an angle of 60 degrees with the main tail Considerable structure showed in the main tail and it had a shredded appearance On the next morning the sky was very hazy and Prof Barnard could see only the nucleus The original of the photograph of September 30th here reproduced shows much detail about the comet's head with a system of many streamers which go out from the head and give the tail a fan shape On this same morning, cometa Brooks and Beljgawsky could be seen at the same time with the naked eye—the former in the northeast near the handle of the Dipper, and the latter in the east near the horizon

Brooks's Comet.

Brooks's has been a most interesting comet because it has remained visible for so long to the naked eye On October 21st, this comet rise, at four o'clock about 20 degrees north of east, and rises about the same time for the week following, but each morning more nearly east Brooks's comet may be found from the diagram in the constellation of the Virgin It will be seen from this diagram that the paths of Beljgawsky's and Brooks's comets cross each other, but at the present time, the former is visible in the evening sky, east of the sun, the latter in the morning sky, west of the sun. The exquisite photograph of Brooks's comet by Prof Barnard, reproduced here, was made at 9 10 P M., September 22nd, with an exposure of three hours and a half, and shows a tail for about 9 degrees. The trails of light on the photograph are the stars which become elongated to lines of ligh, as the comet moved with respect to the stars while the photograph was being taken The comet was followed closely for the 3 hours 30 minutes necessary to make the exposure by keeping the eye constantly at the eye end of the telescope attached to the camera for guiding purposes

The diagram of Brooks's comet shows that it was picked up about as soon as it possibly could be. The diagram also shows that in November the comet will be moving directly away from the earth and will dwindle in brightness very quickly

Quenisset Comet.

This comet is fainter than the other two, and has suffered in consequence. It was discovered 15 degrees from the North Pole. On October 19th It was in the middle of the Northern Crown It passes almost due south about a degree a day from the Northern Crown into the Serpent. It is very slowly increasing in brightness.

Abstracts from Current Periodicals

Phases of Science as Other Editors See Them

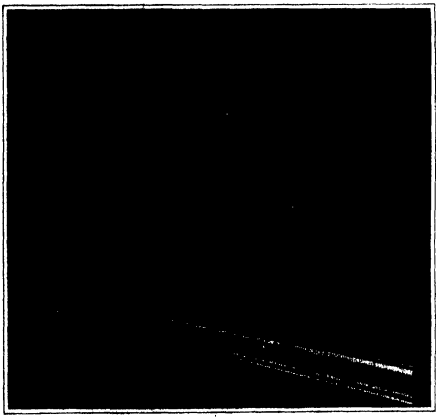
Freaks in Art and Their Scientific Explanation

THE grotesque has always had its place in art. Probably the commonest example of the artist's indulgence in peculiar vagaries of his creative fancy, are the gargoyles which adorn certain portions of Gothic structures. Some logical justification for the introduction of these grotesque figures is derived from the symbolical significance attached to them. Now and again in a work of art is found a similar element of freak, though it is not always easy, in such cases, to divine the author's reasons for resorting to such peculiar eccentricity. Two famous instances of this kind are figured in our illustrations, reproduced from the *Illustrated London News*. The first of these is a copy of Holbein's "Ambassadors," in the foreground of which, apparently without relevance of any kind, appears a skull, distorted almost out of recognition, its outline being roughly fish-shaped. There has been a good deal of discussion as to the significance of this picture. The explanation which bears the greatest semblance of probability is one given by Miss Mary F. S. Hervey, according to which the two personages appearing on the painting are identified as Jean de Dinteville, Ambassador from France to England in 1533, and his friend Georges de Selve. A recent discovery has placed beyond question the correctness of Miss Hervey's conjecture. A companion picture to the one here reproduced has been discovered, on which the same Jean de Dinteville appears, his name being worked into the hem of his garment. The evidence is such as to fully establish the identity of the Ambassador. As regards the mysterious skull in the foreground, Miss Hervey tells us that Dinteville had become acquainted in England with Holbein's "Dance of Death" series, and had adopted the skull as his personal badge.



Holbein's "Ambassadors" with the mysterious skull in the foreground

Our second illustration shows a view of an extraordinary portrait of Edward VI. This portrait is so distorted that it presents a normal appearance only when viewed through an aperture in a screen attached to the side of the frame. The painting is described in the catalogue of the National Portrait Gallery as "Edward VI; King 1537-1553, Painting in Perspective, 1546, by a French Artist." It is difficult to imagine what motive the painter might have had in choosing this strange method of presentation, unless it was purely a desire to do something unusual.



The "Painting in Perspective" of Edward VI.

Man's Fossil Remains

DR. W. D. MATTHEW, Curator of the American Museum of Natural History, has given the following information to the editor of the New York *Times* in answer to a curious correspondent, who asked "How do scientists account for the fact that so very few fossil human bones are found, while those of animals, that seem to have lived in the same period, are plentiful?"

"Human remains," says Dr. Matthew, "are found only in the latest geological formations. No authenticated remains are older than the Pleistocene epoch (ice age). In North America they are all very late Pleistocene. They are not especially rare as compared with the remains of lower animals, but most of the finds are due to interments of one kind or another.

"In the older formations (Tertiary and preceding periods) the bones of extinct animals are found, sometimes in abundance, but no remains certainly attributable to man or to any direct ancestor of man have been found. All reports to the contrary are based on questionable or insufficient evidence. These facts are true of the regions which have been extensively explored for fossil remains, viz., the greater part of Europe, a large part of the United States, and minor areas in other parts of the world.

"The obvious inferences are that man probably did not inhabit those parts of the world until during or after the great ice age, that he did not evolve from lower animals in these regions, and that the practice of interring the dead, instead of leaving them at the mercy of wild beasts, was a very ancient and universal custom among primitive races of man.

"The regions explored are a small fraction—possibly five per cent—of the area of Tertiary formations of the same nature known or believed to exist in different parts of the world. There are vast areas of promising "badlands" in every continent, which have been little or not at all searched by fossil hunters (these specimens are very rarely noticed or recognized by others). Even in the Western States, fifty years of exploration are so far from exhausting the field that every summer some expedition reports finding extinct animals hitherto unknown to science. Nevertheless we know enough to make it very improbable that the ancestry of man will be found in the Tertiary of North America. There is a great deal of indirect evidence, in the present distribution of the races of mankind, and what is known of the history of their migration, and from other sources, all pointing toward Asia, and especially Central Asia, as the original home of the race and the theater of its evolution during the Tertiary period. This is unexplored territory to the paleontologist, and too difficult and dangerous for systematic search even to-day. But if it is opened up to exploration during the next half century as the Western States have been in the past fifty years, we may look to find there the remains of Tertiary ancestors of man along with those of various lower races of animals which are believed to have originated in that region. If, after a thorough search, this belief is not substantiated, explanations will be in order, and it will be necessary for us to modify or reconsider our present views as to where and how man originated."

The Influence of Environment on the Composition of Wheat

THE variation in the composition of plants of the same species when grown under different conditions has been the subject of so much study during the past half century that a monograph published by the United States Department of Agriculture on the subject will undoubtedly be welcomed by students of physiological chemistry. The monograph in question was prepared by Mr. J. A. Le Clerc, with the collaboration of Sherman Leavitt, and is entitled "Tri-Local Experiments on the Composition of Wheat."

The experiments recorded were begun in 1905 with the collaboration of the Office of Grain Investigations of the Bureau of Plant Industry, and consisted in growing wheat from the same original seed continuously in each of the three apices of a triangle, for example (1) in Kansas, Texas and California, (2) in South Dakota, Kansas and California. The crop from each apex was then sent to the other two stations and there grown under the same conditions as the continuously grown seed. There were thus three plots at each apex or station all from the same original seed, one plot grown continuously at that point, the seed of the other two plots coming from the other points of the triangle. By this interchange of seed it was possible to determine the influence of climate and soil and of the kind of seed on the composition of the crop.

From the data obtained the following conclusions may be drawn:

Wheat of the same variety obtained from different sources and possessing widely different chemical and physical characteristics, when grown side by side in one locality, yields crops which are almost the same in appearance and in composition. Wheat of any one variety, from any one source and absolutely alike in chemical and physical characteristics, when grown in different localities possessing different climatic conditions, yields crops of very widely different appearance and very different in chemical composition. These differences are due for the most part to climatic conditions prevailing at the time of growth. The results so far obtained would seem to indicate that the soil and seed play a relatively small part in influencing the composition of crops.

The practice of trying to improve crops in one locality, which crops are to be grown in another locality of widely different climatic conditions, should be discouraged. Crops should be improved in the locality in which they are intended to be grown, or the seed should be selected from a region which has similar climatic conditions.

Rodgers's Flight Across the Continent

AVIATOR C. P. Rodgers reached Chicago at noon on Sunday, the 8th inst. He covered the 26 miles from Hammond, Ind., in 24 minutes, after a delay of two days at the latter place on account of inclement weather. His total flying time for the 1,199 miles was 21 hours and 53 minutes. During the next three days Rodgers succeeded in reaching Kansas City, 1,483 miles from New York, and about half-way across the continent.

Relative Strength of the Italian and Turkish Navies

A Comparison of Fleets Ancient and Modern

EVERY naval conflict, no matter how insignificant, or how great the disparity between the rival fleets, should furnish its quota of that technical information, upon which the designs of fighting ships are based and by which changes in the strategy and tactics of the future are modified. Those of us who have followed modern naval history with any close attention will call to mind the historic fight between Chilian and Peruvian armored ships, and the value which was placed upon the technical results of that struggle.

The principal object lesson of the present war between Italy and Turkey is that of the great value of the command of the sea. War had not been declared many hours before the Turkish government found itself as absolutely separated from Tripoli, the cause of contention, as though that place were located upon the planet Mars instead of upon the opposite shores of the Mediterranean Sea.

The situation will turn the minds of all thoughtful Americans to the far-distant Philippines, Hawaii, and the Panama Canal, and the question will be asked: "Is not four, rather than two battleships a year the correct standard, if we are to hold these distant possessions beyond all possibility of loss?"

Granting that in the strength of their land forces the Italian and Turkish nations are fairly well matched, it is evident at a glance that the disparity in the naval forces is so great as to render the present contest on the high seas almost farcical. If the Turkish navy should give a good account of itself, it will certainly not be because of its strength in ships, guns and men. With few exceptions, all the ships Turkey possesses were obsolete before the keels of the modern fleets of the nations were laid.

The Turkish fleet consist of three battleships, the "Hairredin Barbarosse," the "Torgud Reis" and the "Messudiyeh." The first two are castoffs of the German navy, which were built twenty years ago and were unloaded on Turkey last year. They were formerly the Friedrich Wilhelm and the Wiessenburg, and they carry, each, six 11-inch guns of an old pattern, in three center-line turrets. The armor is of the old compound type and the original speed of the ships was 17 knots. The third battleship, the "Messudiyeh," built in 1874, reconstructed in 1902, is of 10,000 tons displacement, 16 knots speed, and is armored with two 9 2-inch guns and twelve 6-inch, and protected with 12-inch iron armor. These three battleships combined would be no match for any one of the modern Italian battleships.

In the protected cruiser class, Turkey possesses three modern vessels, the "Hamidieh" and a sister ship, both of which were built in Europe. They are of 3,800 tons, and 22 knots speed, and carry two 6-inch and eight 4.7-inch guns. Another modern vessel is the "Medjidieh," of 3,320 tons, built by the Cramps, in 1904. This is also a 22-knot vessel, carrying two 6-inch and eight 4.7-inch guns. All three of these cruisers rely for protection on a 4-inch protective deck.

The rest of the fleet is made up of four obsolete vessels, of 2,400 to 5,000 tons displacement and 12 knots design speed, built in the 60's, carrying iron armor and four 6-inch guns, which are to-day of practically no value. Two 775 ton gunboats, built in 1906, a 500 ton gunboat built in 1907, one of 775 tons built in 1890 and seven of 213 tons and 12-knot speed, built in 1907-09, with eight other gunboats of 200 to 600 tons, and 12-knot speed, complete the list of larger vessels of the Turkish navy.

In destroyers Turkey possesses some modern vessels, including four of 620 tons and over 30 knots, and four of 305 tons and 28 knots. The navy includes also fourteen torpedo boats, built between 1901 and 1907, of 26 to 27 knots speed.

From the above enumeration it will be seen that the Turkish navy is incapable of fighting a fleet action with a modern navy. Her fast cruisers, in the hands of skilfull and daring officers, might prove effective in damaging Italian commerce or threatening the line of Italian communications, although Italy's fast cruisers should be able to capture and destroy these vessels or drive them under the shelter of Turkish land fortifications.

The Italian navy is worthy of a maritime people who have contributed largely to the development of the modern types of war ships. The battleships in particular are noted for carrying unusually heavy armaments and possessing speeds that are higher than the average of other navies. The most important vessels are three of the "Conti di Cavour" class, 21,500 tons and 22.5 knots, which are the first battleships to carry thirteen 12-inch guns, nine of them in three 3-gun turrets and four in two 2-gun turrets, all on the center line. Practically completed is another fine ship, the "Dante Alighieri," 19,000 tons, 23 knots, which will carry twelve 12-inch in four 3-gun center line turrets.

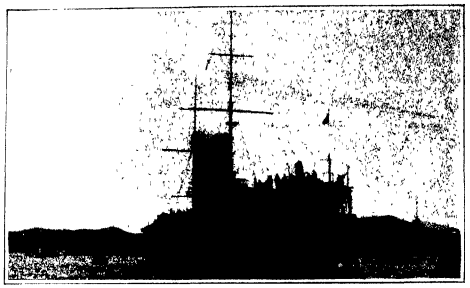
Of pre-dreadnoughts the Italian navy possesses four of the "Vittorio Emanuele" class (1904-7), viz., the "Emanuele," "Regina Elena," "Napoli" and "Roma"; 12,625 tons, 21 knots, carrying in turrets two 12-inch and twelve 8-inch, and protected by a 10-inch belt of Terni face-hardened armor. The "Benedetto Brin" and "Regina Margherita" (1901), of 13,427 tons and 202 knots are heavily armed, but lightly protected battleships, mounting in turrets four 12's, four 8's and twelve 6's, and protected by a belt of only 6-inch maximum thickness. The "San Giorgio" and "San Marco" (1908), of 9,830 tons and 23 knots, carry four 10's and eight 7.5's, all in two-gun turrets. They are protected by an 8-inch belt. The "Pisa" and "Amalfi" (1907-8), of 10,118 tons, 23 knots, carry the same armament and belt.

In armored vessels the Italians also possess five armored cruisers, of 7,400 to 9,800 tons (1897-1902), which are of the same general class as the "Cristobal Colon," of the Spanish war, and the "Kasuga" of the Japanese navy. These are the "Garibaldi," "Varese" and "Francesco Ferruccio," of 7,400 tons and 20 knot speed, protected by a 6-inch belt, carrying one 10-inch gun and two 8-inch in turrets and a broadside of fourteen 6-inch. The other two are the "St. Bon" and "Filiberto," 9,800 tons, 18 knots speed, 9¾-inch belt, carrying four 10-inch in turrets and eight 6-inch and eight 4.7-inch guns in broadside. The "Carlo Alberto" and "Vettor Pisani" (1895-96), 6,500 tons and 19 knots, are protected by a 6-inch belt and mount twelve 6-inch and six 4.7-inch in broadside. The "Marco Polo" (1892), 4,583 tons, 19 knots, protected by a 4-inch belt and mounting six 6-inch and four 4.7 inch, dates from 1892.

The above completes the list of modern armored vessels of the Italian navy, and the fact will be recognized that the ships are generally of first-class design.

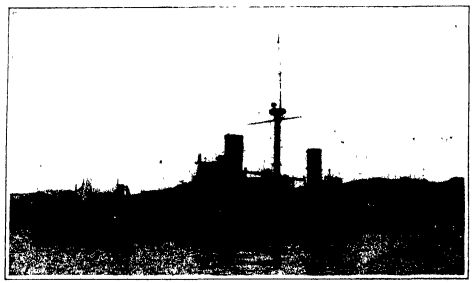
Of old armored vessels Italy possesses the "Sicilia," the "Re Umberto" and "Sardegla" (1887-91), of 13,500 tons and about 18 knots speed, armed with old 13.5 and 6-inch guns, and protected by a 4½-inch belt. Then there are the "Dandolo," "Italia" and the "Lepanto." The first-named was built in 1878, and mounts four 10-inch, seven 6-inch and five 4.7 inch guns. The "Italia" and "Lepanto," of about 15,500 tons, built in 1880-83, were phenomenal ships of their day, since they had no belt armor and yet mounted four 17-inch 100-ton guns. They were originally built for 18 knots.

(Continued on page 877.)



Displacement, 12,625 tons. Speed, 22.5 knots. Belt, 9 inch. Guns, two 12-inch, twelve 8-inch.

Italian battleship "Regina Elena." "Emanuele" class. 1905-7.



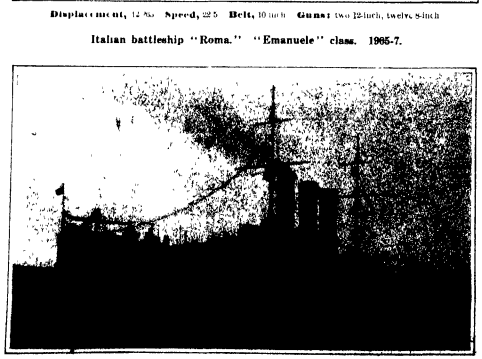
Displacement, 9,800 tons. Speed, 18.4. Belt, 9¾ inch. Guns: four 10-inch, eight 6-inch, eight 4.7-inch.

Italian battleship "St. Bon." Also "Filiberto." 1897.



Displacement, 12,625 tons. Speed, 22.5. Belt, 10 inch. Guns: two 12-inch, twelve, 8-inch.

Italian battleship "Roma." "Emanuele" class. 1905-7.



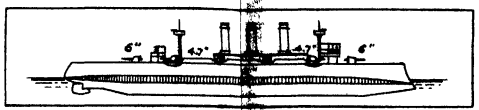
Displacement, 13,427 tons. Speed, 22.5 knots. Belt, 10 inch. Guns: two 12-inch, twelve 8-inch.

Italian battleship "Vittorio Emanuele." Four ships. 1904-7.



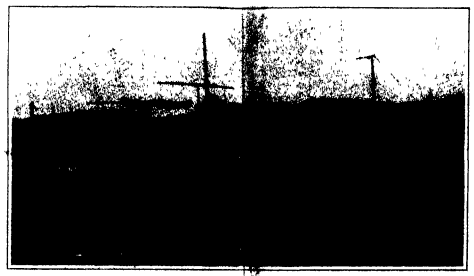
Displacement, 10,000 tons. Speed, 17 knots. Belt, [illegible]. Guns: six 11-inch; eight 4-inch. Date, 1891.

Turkish battleship "Torgud Reis." Also "H. Barbarosse."



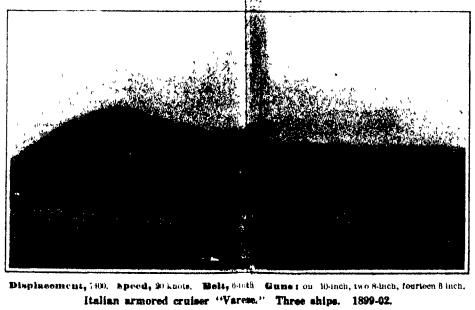
Displacement, 3800 tons. Speed, 22 knots. Deck, [illegible]. Guns: two 6-inch, eight 4.7 inch. Date, 1903.

Turkish cruiser "Hamidieh." Class of three ships.



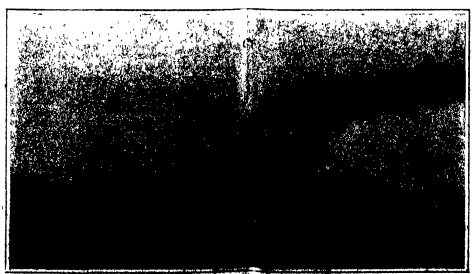
Displacement, 160 tons. Speed: surface 11 knots, submerged 9 knots. Two torpedo tubes.

Italian submarine "Narvalo." Five vessels. 1903-6.



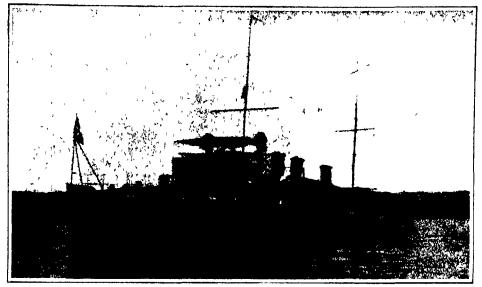
Displacement, 7900. Speed, 20 knots. Belt, 6-inch. Guns: one 10-inch, two 8-inch, fourteen 6 inch.

Italian armored cruiser "Varese." Three ships. 1899-02.



Displacement, 10,118 tons. Speed, 23.6 knots. Belt, 6-inch. Guns: four 10-inch, eight 7.5-inch.

Italian battleship "Amalfi" [illegible] "Pisa." 1907-8.



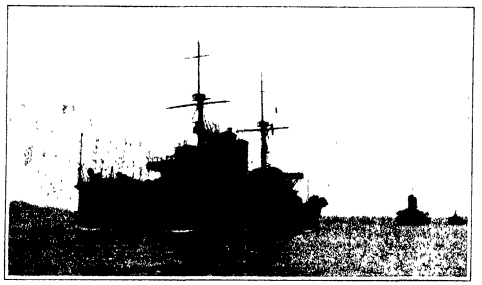
Displacement, 240 tons. Speed, 28.5. Torpedo tubes, three. Guns, four 4-inch.

Italian destroyer "Bersaglieri." Ten boats. 1907-10.



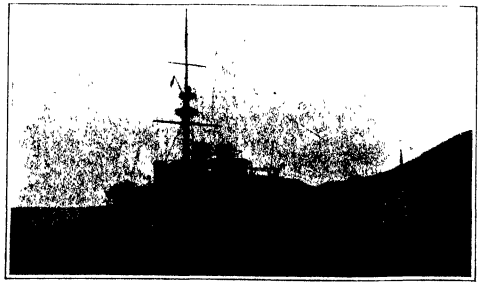
Displacement, 6300 tons. Speed, 19 knots. Belt, 6-inch. Guns, twelve 6-inch, six 4.7-inch.

Italian armored cruiser "Pisani." Also "Alberta." 1895.



Displacement, 13,427 tons. Speed, 20.2 knots. Belt, 6-inch. Guns, four 12-inch, four 8-inch, twelve 6-inch.

Italian battleship "Regina Margherita." Also "Benedetto Brin." 1901.



Displacement, 13,351 tons. Speed, 18 knots. Belt, 4½ inch. Guns, four 13.5 inch, eight 6-inch, sixteen 4.7 inch.

Italian battleship "Re Umberto." Three ships. 1887-91.

Small Isolated Electric Power Plants

Some Practical Suggestions on Building Them

By Frederick E. Ward

EVER since the invention of the incandescent lamp, and its resulting widespread adoption for the lighting of dwellings, many persons living outside the zones supplied with current by central stations have desired to possess small lighting plants of their own. Heretofore, however, this has not been practical for the man of moderate means, because of the large amount of power consumed by the carbon-filament lamp and the necessarily large outlay for equipment and running expenses.

Recent progress in the lampmaker's art has resulted in giving us the tungsten filament, which is three times as economical in the consumption of power as the old carbon lamp, so that now an ordinary sized dwelling can be brilliantly lighted by so simple and inexpensive an outfit as would seem to place this with *in the reach of a* great many who cannot get electricity from central stations.

The following description will give first a good idea of a suitable plant for the practical lighting of a house wired for a total of about eighteen sixteen candle-power lamps. As all the lamps located in the various parts of a house are not required to be lighted at the same time, it is assumed that ordinarily not over seven lamps will be used, and that the maximum demand on special occasions such as receptions or parties, will be for twelve lamps to burn all night.

In cases where a plant is to be installed principally for lighting, and it is not intended to operate electric heating devices or motors, except in small sizes and only occasionally, then thirty-two volts is probably the best selection that can be made for the system. This has been adopted as a standard voltage for the lighting of railroad cars, and tungsten lampmakers are prepared to furnish lamps for it in candle-power of 8, 12 and 16.

The necessary equipment of a plant consists of four parts, the engine, the generator, the switchboard and the storage battery. In general it is best to buy these from manufacturers who make a specialty of such apparatus, but the Handy Man who can spare the time can no doubt derive much pleasure from making a large part of the apparatus himself, as hereinafter more particularly described.

An electric lighting outfit takes up but little room and may be installed in one corner of the tool-house, garage or other outbuilding if one does not wish to erect a separate house for it. In the photograph in Fig. 1, is shown a neat power-house of field stone built over a live spring at the foot of a hill. The same engine that runs the dynamo also drives a lathe and grindstone, as well as running a pump supplying the house tank with water from the spring.

The simplest and most economical form of storage battery to buy is known as the two-plate, or couple type, which consists of two plates in each jar, supported by hard connecting straps resting across the edges of the adjacent jars. Sixteen cells are required for a thirty-two volt system, and these, having a capacity of thirty-six ampere-hours, can be purchased for about fifty-five dollars.

Sometimes a bargain can be found in the way of a battery, suitable for a very small plant in the second hand or discarded electric vehicle battery of the lead type. Cells of this kind, when new, have a capacity of about 120 ampere-hours, but this is soon reduced by the severe conditions of service, and when the point is reached where the vehicle will no longer run a sufficient number of miles on a charge the battery plates have to be replaced by new ones. The old plates, which go back to the melting pot, usually can be purchased for very little money, and, when properly cleaned and assembled in suitable glass jars, will give many months of useful service.

For those who prefer to make their own batteries, however, some good hints were given in this department of the SCIENTIFIC AMERICAN of March 11th, 1911. A simpler form of construction has been devised by the author, embodying the modifications shown in the upper left-hand corner of Fig. 2, where the positive and negative elements are separated by a porous earthen flower-pot instead of by strips of wood. This construction has the advantage of a considerable saving in labor, as the lead cylinders do not have to be nicely made or riveted, and of an increase in useful life as short-circuits cannot be formed by active material falling to the bottom of the jar between the plates.

As the capacity of a cell of this kind is not directly proportional to its weight, it is more desirable to make thirty-two small cells than sixteen larger ones. The small cells can be connected in two series of sixteen each, thus becoming equivalent to sixteen cells of double the size. For those who have had little or no previous experience in this kind of work it is recommended that only one-half of the batteries be made to start with, and that the second half be attempted only after the first series have been put in service long enough to show up possible defects.

For a cell of suitable capacity, the containing vessel may be a glass jar or a glazed earthen crock having inside dimensions not less than 5½ inches diameter by 5½ inches high. The flower-pot may be 4½ inches outside diameter at the top by 4¼ inches high. Plug up the hole in the bottom by standing the pot on a sheet of paper and pouring in just enough melted sealing wax to fill the hole, but not to cover the bottom.

In assembling, put a thin layer of the granulated lead in the bottom of the crock *J*, and pack it down well. Stand the flower-pot *P* in the middle, and bend one strip of 1/16 inch sheet lead *E* to fit inside the pot and one to fit outside. These "cylinders" may be

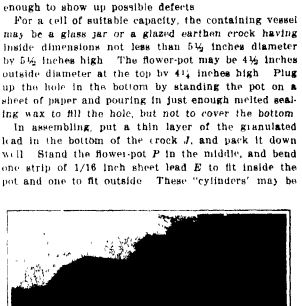


Fig. 1.—A small power house.

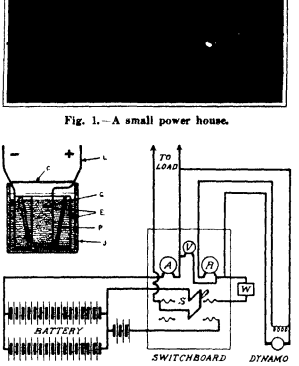


Fig. 2.—Details of storage cell and diagram of connections.

the same height as the pot, and the terminal straps *L* may be formed by bending up strips one inch wide partly cut from the metal, thus doing away with riveted connectors. Pack the remaining spaces in the crock and the pot with granulated lead *G*, up to within a quarter of an inch of the rim of the pot. It is very important to arrange the connecting straps *L* so that they may be bent to pass out at diametrically opposite points close to the rim of the crock, so as to leave room between them to lay a square of glass *C* to serve as a cover. These covers are necessary to catch the fine spray of acid that would otherwise fly out during charging.

A cell of the dimensions given requires a total of about seven pounds of lead, of which about 4¾ pounds are granulated. Granulated lead is prepared by heating melted lead red hot in the ladle and then pouring it from a height of about five feet into a pail of water. In storage battery work success depends largely on the use of pure materials. In selecting the lead for granulating reject anything suspected of containing solder, zinc or other impurities. Never use the cheap, or "commercial" sulphuric acid, or water that is "hard." Use a good quality of acid and either distilled or rain water.

The proper electrolyte to use in the cells is dilute sulphuric acid of a specific gravity of 1.2. This can be purchased already prepared, or it can be made by slowly adding one part of concentrated acid to each five parts of water. When the cells are filled to a point one-quarter of an inch above the flower-pots, the level of the liquid should be nearly an inch below the tops of the crocks.

The completed cells should be arranged in shallow wooden trays, the bottoms of which are covered with a layer of clean sand about half an inch deep. Not more than eight cells should be grouped in a single tray, on account of leakage of current over the surface of the jars and through the sand. After the jars are in place, the surface of the sand all around them may be liberally dusted with dry sodium bicarbonate (baking soda) which not only neutralizes any acid that slops over on the sand, but tends to keep the last dry, as the sodium sulphate formed is an efflorescent salt.

It is well to remember that a solution of bicarbonate of soda in water is the best wash for use in the event of any acid getting spattered in one's eyes, and the author recommends that a bottle of this be kept in a handy place for use in such an emergency.

Thirty-two of the cells made as described will cost less than twenty-five dollars for the materials alone, but to this must be added the cost of current used in the forming process, which takes considerable time.

To form the cells properly a current of three or four amperes should be passed through each series of them, either continuously or intermittently for a total of about fifty hours. Then they should be completely discharged and reversed, or given a similar charge in the opposite direction. About ten such reversals are required to develop sufficient capacity for practical purposes. When this has been accomplished always charge the cells in the direction that makes the central plate positive.

For charging the battery a shunt-wound generator, or dynamo, is required. For those who may care to build this part of the apparatus, the design given in SCIENTIFIC AMERICAN SUPPLEMENT, No. 600, is to be commended on account of its very complete description. A machine built in accordance with those instructions may be made to serve a useful purpose, especially if it be provided with more modern ring-oiling bearings and carbon brushes, to insure against the need of shutting down for hot boxes and commutator troubles. A more modern and dependable generator, however, can be purchased for about twenty-five dollars. In ordering a machine it should be required to meet the following specifications: Volts, 42; amperes, 5; speed, 1,800 to 2,000 revolutions per minute; type, shunt generator.

The most satisfactory kind of power to use for driving the generator is the small gasoline engine. One-half horse-power would be ample for this purpose, but as yet few engine makers have developed anything in so small a size, so that good, reliable engines are to be had only in sizes beginning with about one horse-power, and costing from thirty dollars upward. Where there is water power available even less than one-half horse-power will give good results, since the water-wheel requires no attention and may be allowed to charge the battery slowly and for long periods of time.

Where one already has any kind of power at hand it may not be necessary to buy an engine to run the generator. For wherever there is a steam engine, gasoline engine or a water-wheel already installed for doing other work, a suitable pulley and belt may be arranged to drive the generator, and the power thus absorbed will be so small that in many cases it never will be missed.

A simple and convenient arrangement of the switchboard connections is also shown in Fig. 2. It is necessary to have an ammeter *A* to measure the current passing through the battery. The most desirable scale is one having the zero in the middle and reading up to ten amperes on each side, showing charge or discharge. A voltmeter *V* is also a great convenience, but is not essential, as the working of the generator can be indicated by a 4 candle-power 16-volt lamp.

In order to charge the storage battery, the dynamo must impress upon the battery's terminals a voltage considerably higher than thirty-two. This means that if any lamps are lighted while the charging is being done they will take so much current at the increased pressure as to be quickly burned out. To guard against this mishap there are shown in the diagram three extra cells of battery in addition to those previously mentioned. These extra cells are called c. e. m. f. (counter electro-motive force) cells, and their purpose is to oppose or neutralize about one-fifth of the pressure that would otherwise be applied to the lamp. The c. e. m. f. cells may be more easily made than the

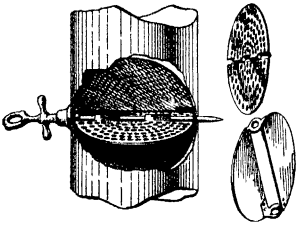
(Continued on page 378.)

The Inventor's Department

Simple Patent Law; Patent Office News; Inventions New and Interesting

Oddities in Inventions

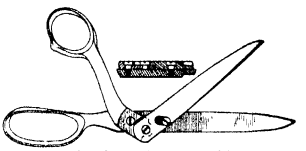
Safety Spark and Draft Damper.—Threatened with a fire in his own home by sparks passing up through the stove pipe into the chimney and alighting on the shingle roof, an inventor recently designed the damper illustrated in the accompanying photograph. It consists of two parts, one f which is the damper proper and the other the spark arrester. The spark arrester has a perforated disk which along the center line is stamped to form a square socket or a spindle. Mounted on this spindle is a handle that operates the draft damper. In use, the spark arrester normally lies crosswise in the stove pipe and the draft damper may be operated at



Combined spark arrester and draft damper.

will by turning the handle on the sleeve. A perforated plate prevents the sparks from passing up through the chimney and it also collects soot which would otherwise clog the chimney. Whenever it is desired to clear the plate of soot, the spindle may be turned, causing the spark arrester disk to strike against th draft damper and thus shake off the soot.

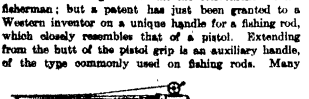
Shears With Compound Leverage.—Scissors or shears as ordinarily constructed r present the simplest type of leverage. Two inventors living in Oregon have sought to improve on this by producing a compound leverage, at the same time the blades are so arranged as to afford a draw cut, thereby improving the efficiency of the device, particularly when cutting heavy materials. As will be noted in our illustration, one of the blades is



Draw-cutting shears with compound leverage.

integral with the handle, while the other blade is fulcrumed on a screw in the first blade and is hinged to the short arm of a lever that constitutes the other handle. The fulcrum of the blade jus referred to is not fixed; instead, the blade is slo te so that it is movable endwise upon its fulcrum, to oo pensate for the arc of travel of the short arm of the handle lever. When the handles are brought together there is a toggle action on this blade, while its movement upon its fulcrum produces the desired draw cut.

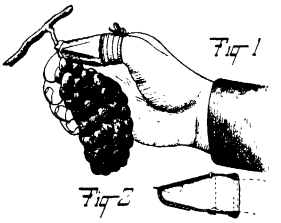
Pistol Handles for Fishing Rods.—Heretofore no particular care has been exercised in designing the handle of a fishing rod to suit the convenience of the fisherman; but a patent has just been granted to a Western inventor on a unique handle for a fishing rod, which closely resembles that of a pistol. Extending from the butt of the pistol grip is an auxiliary handle, of the type commonly used on fishing rods. Many



Fishing rod with pistol grip.

advantages are claimed for this double form of handle. The fisherman in ordinary still fishing may support the auxiliary handle under his forearm while grasping the pistol grip in his hand. This will give him a much better leverage for handling a fish, and will be less tiring.

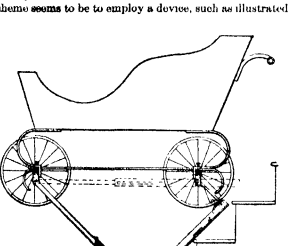
Thumb Knife for Picking Fruit.—A very convenient device for picking fruit has been designed by a man living in the fruit regions of California. It consists of a thimble, which may be tied to the thumb and which terminates in a blade with a keen edge. The fruit is seized in the hand and the stem is severed by means of



Picking fruit with a thumb knife.

the thumb knife. With such a device as this the picking of fruit is materially expedited and there is no danger of tearing the branches or marring the fruit when it is plucked.

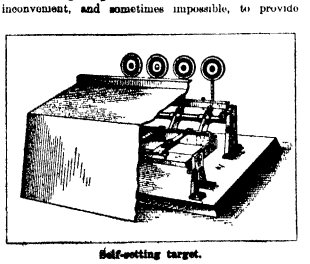
Stairway Skids for Baby Carriages.—It is always a precarious task to take a baby carriage, step by step, down a stairway. Not infrequently the handle gives way and the carriage is dashed to the bottom. Furthermore, the jar of bumping down the steps cannot be entirely avoided, and is injurious to the child. A better scheme seems to be to employ a device, such as illustrated



Up and down steps on skids.

herewith, which consists in a pair of skids that slide smoothly down the steps. The skids are permanently secured to the carriage and normally occupy the position indicated by dotted lines. When it is desired to use them, they are adjusted to the position shown in full lines. The skids are held in this position by bars attached to the front axle, which have sliding connection with the skids and hence, under normal condition, may be telescoped with them.

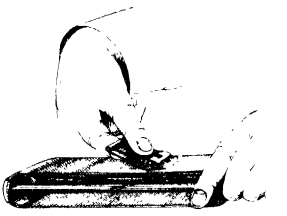
Self-setting Target.—Under certain conditions it is inconvenient, and sometimes impossible, to provide



Self-setting target.

manually operated target resetting devices, particularly for long ranges. In such circumstances, the self-setting target here illustrated should prove of value. The targets, which may be of any number desired, are mounted on bell-crank levers, weighted to keep them upright. When a target is struck by a bullet, the lever is swung on its axis, and the toe of the weighted arm snaps past a leaf spring, which serves to retain the target in depressed position. Target after target may thus be depressed, but when the last of the set has been shot down, the entire series of targets is reset. The leaf springs which hold the individual targets are mounted on a frame which is normally held in horizontal position by a counterweight. The accumulated weight of the entire series of bell-crank levers is sufficient to overbalance this counterweight, causing the frame to swing on its axis and liberate the levers, which thereupon swing back to their normal position.

Razor-stropping Device.—The advent of the safety razor has made necessary the use of special forms of razor strops, particularly adapted for sharpening the short handleless razor blades. One of these razor stropping devices is illustrated herewith. The razor blade is gripped by a small carrier connected by a pair of



Razor-stropping device.

links to a frame around which the razor strop is stretched. Owing to the double link connection with the carrier, the razor blade is always maintained at the proper angle with respect to the strop, as it is moved along the leather. At the end of the stroke the two links serve to lift the blade clear of the strop, permitting it to be turned over to bring the opposite side to bear.

Ever-level Table for Ships.—Many different types of tables and chairs have been invented for use on ships in time of storm. As a rule they are designed on the pendulum principle and are arranged to swing relatively to the ship, under the action of gravity, thus maintaining a constant horizontal position. The objection to this scheme is that the table or chair is apt to sway, and is never perfectly steady. Seeking to overcome this difficulty, and inventor in Texas has designed the table pictured in the accompanying drawing. The table top is mounted on a ball joint, which is supported on four



Ever-level table.

legs secured to the deck or floor of the vessel. Extending from this ball joint is a rod supporting a heavy weight at its lower end. This is the pendulum that holds the table top level. However, in order to damp the oscillation of the pendulum, four oil cylinders are attached to the table legs, while the plungers that play in these cylinders are connected by ball joints to the pendulum rod. The cylinders are filled with oil and the plungers are provided with perforations, to permit the passage of the oil through them as they move in and out of the cylinders. The viscosity of the oil tends to make the pendulum move sluggishly, but not so sluggishly as to prevent the table from keeping its horizontal position as the ship rolls.

Notes for Inventors

Attitude of Patent Office Toward Perpetual Motion The Patent Office regards perpetual motion as meaning a mechanical motion which creates energy, that is to say a machine which works and operates without the aid of any power other than that generated by the machine itself and which machine, when once started, will operate for an indefinite time The Patent Office also holds that these views are in accord with those of the scientists who have investigated the subject and are to the effect that mechanical perpetual motion is a physical impossibility These views can be successfully rebutted only by the exhibition of a working model, and while many persons have filed applications for patents on perpetual motion, such applications have been rejected as being inoperative and as opposed to well-known physical laws and in no instance has the requirement of the Patent Office for a working model been complied with The Patent Office will not now permit an application for patent on perpetual motion to be filed without a model, this practice having been adopted by the Patent Office to save applicants for patent the loss of fees paid with their applications in cases where perpetual motion has been claimed After an application for patent has been considered by the Patent Office Examiner, the first government fee of $15 00 cannot be returned

Five Patents to a Montclair Inventor. Among the patents issued September 5th, 1911, are five patents, No 1,002,246 to No 1,002,249, and No 1,002,506, to Carleton Ellis of Montclair, N J., assignor to Ellis-Foster Company, for continuous process and apparatus for making white lead, Agricultural Spray Composition, Inoculated Humus and Process of Making Same, Electrical Oxidation of Nitrogen and Seasoning Material and Making Same

A Telephone Mouth-piece Improvement. Gustavus A Durvee of New York city has patented, No 1,002,248, a telephone attachment in which the mouth-piece is yieldingly supported in a casing, mounted upon the transmitter, so that the mouthpiece can adjust itself to the mouth of the speaker

A New Carwheel Molding Flask.—Alfred Cordingly of Denver, Colo., has secured a patent, No 1,003,709, for a carwheel molding flask with upper and lower sections, with upwardly projecting portions on the lower section which are bevoled to engage the upper section and maintain the sections in proper relation

A Safety Device for Flying Machines.—In patent No 1,003,711, to Josiah W Dalson of New York city, is shown a parachute having a lock for holding it normally collapsed and close to an aeroplane, together with means for automatically opening the parachute when the lock is released and for spreading the parachute when the lock is released the parachute being detachably connected to the aeroplane and having secured to it a take-off connection for supporting an aviator

High Speed Trolley Wheel. The patent, No 1,003,862, to Albert H Armstrong of Schenectady, N Y, assignor to the General Electric Company, presents a high speed trolley wheel which carries at its periphery and pendently pivoted blades which form freely movable contact making means that can be projected outwardly by centrifugal force to make contact with the trolley wire, irrespective of its varying distances from the axis of the wheel, and a motor is provided to positively rotate the trolley wheel

An Automobile Door Indicator.—Patent No 1,003,867, to Leon L Bories of San Francisco, Cal., provides for notifying a chauffeur when an automobile door is closed. This is done by providing a door actuated mechanism which serves, when the door is closed, to operate a suitable indicator

Paper as a Substitute for Laths—A novel plaster support for wall covering and forming a support for plaster, comprises a flexible, laminated sheet of paper board, capable of being compactly rolled and spaced, thin, flat strengthening strips extending transversely of and secured to one surface of the paper board This was patented, No 1,003,754, to Frederick L. Kane of Huntington, N. Y

A New Barber's Comb.—A hair-cutter's comb is shown in patent No. 1,003,588, to James L Woods of Cedar Rapids, Iowa It has teeth which gradually diminish in length from end to end of the comb, with one edge of the teeth formed with inclined portions and the remaining portion straight or parallel with the opposite edge of the teeth, so the comb can be utilized as a gage in cutting hair

Metal Railroad Ties.—Three patents, No 1,003,637 to No 1,003,639, have been granted to William Henry Morgan of Alliance, Ohio, for metal railroad ties, all three of the ties being characterized by cross or transverse portions and end portions which extend lengthwise the rails for supporting the latter

A Two-part Medicine Bottle.—A medicine bottle, having a bottle within it with the stopper of the inner bottle seated in the inner end of the stopper of the outer bottle, is shown in patent No 1,002,293, to Richard P McGrann of Lancaster, Pa

An Electrically Heated Hot Water Bag.—Patent No 1,002,253 presents a hot water bag having a removable stopper and an electrode carried by the stopper and exposed within the bag, the stopper having on its outer side special means for connection with an electric circuit, the electrode being removable with the stopper.

A Novel Lubricating Material.– Henry P White of Kalamazoo, Mich., presents in a patent, No 1,002,349, a packing material which includes crumpled sheet metal, coated with oil and powdered graphite and folded and compacted together

A New Mergenthaler Line Caster.–John R Rogers of Brooklyn, N Y, has assigned to the Mergenthaler Company a patent, No 1,002,320, for a line casting machine which has a magazine for use in an inclined position, which has a straight channeled body portion and a straight receiving end in alignment with the body portion and vertically partitioned

Detection of Counterfeits.—Patent No 1,002,900, to Edward Robert Morris and Alfred Edwin Bantree of London, England, provides for detecting counterfeits by applying to the fabric of the document distinctive identifying characters or designs and a ground work as specified, the characters and designs being discernible only by aid of a detector in the form of a special light

Two New Edison Patents – Thomas A Edison has in the *Gazette* of September 5th, 1911, two patents, one No 1,002,504, *for an apparatus for crushing* and separating fine materials, and the other, No 1,002 505, for a composition for sound records and other objects The latter is assigned to Thomas A Edison, Incorporated, and the composition includes shellac and a halogenized Naphthaline, crystallizing as fibers distributed through the shellac

An Allis-Chalmers Turbine.—Max Rotter of Milwaukee, Wis, has assigned to Allis-Chalmers Company, of the same place, a patent, No 1,002,813, for a turbine in which an exhaust pipe extends from an engine and is divided into two paths, one of which communicates with a condenser and the other path leads to the turbine, while a governor controls valves which limit the flow through the two paths

Wanted: An Automatic Doffer.—If someone could invent an efficient, satisfactory doffing machine for cotton spinning machines that would be automatic in its operation, it would doubtless quickly come into general use It should be applicable to the various styles of spinning frames and should not be limited in its usefulness to any particular style of bobbin, but should be capable of operating in connection with any of the different forms of bobbins met with in the modern spinning machine.

Legal Notes

"Collier" a Descriptive Term for Dynamite.—In the case of the Sinnamahoning Powder Manufacturing Company, the Patent Office has held that the word Collier, as applied to dynamite, is descriptive and not registrable, since it would indicate to the trade that it was intended for use in coal mining; also that the color of the package in which goods are placed cannot constitute a trade-mark for such goods, and that the Examiner of Trade-marks properly refused to allow the applicant to describe the mark as appearing on a red package

Acquiring Trade-mark Rights.—In acquiring the exclusive right to the use of a trade-mark, the important act is the actual use of the mark on the goods to which it applies, in commerce This, of course, includes the adoption of the mark, since it cannot be used until after its adoption, but the adoption alone of the mark, apart from a *bona fide* use thereof does not give any trade-mark rights therein. When once begun, the use of the mark must be continuous, since any cessation in the use tends to abandonment. The continuity of use depends on the goods; the market for some goods, fertilizers, seed corn and the like, has seasons of activity and seasons of quiet and the use of the mark follows the seasons.

Lecture on Trade-marks.—That the systematic study of trade-mark law is receiving more attention in the established schools of law, is evidenced by the announcement that this season Mr. William L Symons, the Assistant Examiner in the Trade-mark Division of the Patent Office, will deliver courses of lectures on the subject of Trade-marks, Prints and Labels and Unfair Competition in Trade, in the Washington College of Law, Washington, D C.; the Richmond College, School of Law at Richmond, Va., and the Washington and Lee University School of Law, at Lexington, Va

An Important Decision on Reissues.—In the U S Circuit Court of Appeals, Seventh Circuit, in Moneyweight Scale Company, the Court affirmed the decree below, sustaining the Reissue Patent, No 12,137 The Court said

"Authority to grant reissues is now derived exclusively from the statute (R S 4916, U S Comp St 1901, p 3383) And the Commissioner goes beyond his jurisdiction if he grants a reissue for an invention (though conceded to be the invention of the applicant) which is not the same invention that was disclosed and described as the applicant's invention by the original patent, which, by reason of inadvertence, accident, or mistake, is inoperative to secure the monopoly it shows on its face was intended to be secured"

Referring to the original patent, the Court says

"The two claims allowed do not fulfill the promise They are only for combinations of less than the total number of elements in the complete scale and are expressed in general terms The original patent on its face was therefore inoperative to protect the details of construction which the specification has particularly pointed out and which individualized the machine that appellee was manufacturing thereunder"

As to some of the claims presented during the prosecution of the original application, it is said

"We have examined each of the twenty-seven rejected claims and have failed to find one that would be adequate to secure a monopoly of the DeVilbiss computing scale, that would cover the details of construction in which the invention as an entirety resided."

The decision refers to the fact that none of the reissue claims corresponds with the subject matter of any abandoned claim; and that no reissue claim is broader than the allowed claims, and points out that—

"Where none of the original claims presented by an applicant for a patent was adequate to cover the invention disclosed by the specification and drawings, acquiescence in the rejection of such claims is not an abandonment of the invention as an entirety, and the failure of his solicitors to submit adequate claims is an inadvertence which may entitle the applicant to a reissue."

RECENTLY PATENTED INVENTIONS.

These columns are open to all patentees. The notices are inserted by special arrangement with the inventors. Terms on application to the Advertising Department of the SCIENTIFIC AMERICAN.

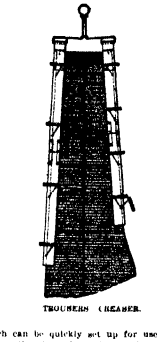
Pertaining to Apparel.

TREAD FOR BOOTS AND SHOES.—W. S. ACKER, Washington, D. C. The primary object of the inventor is to obviate many objectionable features and to present to the trade a heel or tread having a plurality of longitudinal wear resisting strips embedded therein so as to prevent slipping when walking on smooth or wet pavements, the invention being particularly adapted for use with cushion heels, as the strips do not impair the elastic or resilient properties thereof

REINFORCEMENT FOR GARMENT FORMS.—E. T. PALMENBERG, New York, N Y., and F W KRUESCH, Bayonne, N J. The object here is to provide a reinforcement for forms arranged to prevent cutting into the cloth covering of the form by the shears of the fitter, at the same time permitting the insertion of pins or similar fastening devices, generally used for holding the garment temporarily in place on the form during the fitting process.

SKIRT.—A. GOLDBERG, New York, N. Y. The aim of the improvement is to provide a simple and durable skirt, petticoat or the like, which can be easily put on and taken off, the waist band of which is adjustable so that the skirt can be worn by persons having different waist measurements, and which provides pockets for carrying valuables and the like

TROUSERS CREASER.—A. DOMBROWSKY, Las Cascadas, Panama. In this patent the invention is an improvement in trousers creasers and is fully shown in the side view illustration of the device as in use. The inventor's object is to provide a simple and novel construction which will be efficient in use, made in sections which can be conveniently detached to permit the device to be packed in small space and



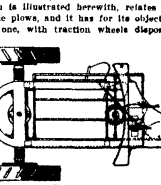
TROUSERS CREASER.

which can be quickly set up for use By adjusting the clasp shown in the dotted line position at the bottom of the right hand side, it will operate to hold the side bars of the clamp firmly upon the trousers If desired, the clamps may be made one longer than the other to adapt them for use at the front and rear edges of the trousers leg as shown

NECKTIE.—I LEWIS, New York, N Y This article is an improved form of reversible entirely woven necktie One of the objects of the invention is to provide an all-woven necktie which comes from the loom completely woven, having the neckband thereof the common tubular construction and the ends forming with the neckband a reversible open-ended four-in-hand tie

Of Interest to Farmers.

AUTOMOBILE PLOW.—OLIVER H LINCOLN and EDSON O PARKHURST, Brownell, Kan This invention, the sectional side view of which is illustrated herewith, relates to automobile plows, and it has for its object to provide one, with traction wheels disposed near



AUTOMOBILE PLOW.

the front and at all times in the same position relatively to the engine, whether the plow is being driven in a straight line or is being turned to one side or the other, the plowshares being disposed under the engine and

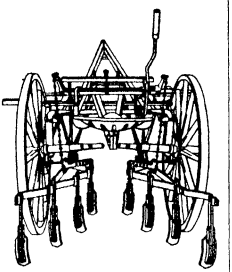
being held down to their work by the weight thereof. By a movement of a lever the plowshares may be moved up or down to a position where they will engage the earth and will do the general work desired, these plowshares being secured to the lower frame having the transverse members.

DEVICE FOR AERATING, COOLING, AND CLEANING MILK.—C. W. TICKNOR, Mount Kisco, N. Y. The intention in this case is to provide a conduit having ribs for collecting any dirt which may be in the milk, the conduit being cooled by an adjoining receptacle containing water, so that the milk will not only be cleaned, but will also be cooled and aerated when passing through the conduit

CULTIVATOR.—W. E. BROWN, Herrick, S. D. In this machine the operator has an easy and complete control. He can follow a row closely without covering or plowing up plants that may be on one side of the row. The disks may be guided to follow a row, regardless to a certain extent of the position of the supporting frame. In this movement both hands are left free for operating other parts of the machine, thus effecting the saving of time and the operator's strength.

MOTOR DISK PLOW.—J. M. HENTON, Edgemont, S. D. This invention provides a carrying frame and traction mechanism with means arranged to propel the frame intermittently and as controlled; provides means for, at will, varying the position of the driving wheels of the traction mechanism relatively to the grinding wheels of the frame to vary the pivot on which the frame is swung; provides rotary plowing members and a rotary driving mechanism arranged to rotate the plowing members independently of the traction mechanism of the carrying frame; provides devices for gripping the ground in a manner to form traction devices auxiliary to the main traction mechanism; and provides rotary plowing devices having means for shearing surface vegetation and shattering subsoil.

CULTIVATOR.—CLIFFORD A. CORWIN, P. O. Box 466, Riverhead, L. I., New York. The cultivator shown in rear perspective view in elevation, is of the adjustable type. The purpose of the inventor is to provide one with a series of hoes connected together so as to be adjusted simultaneously with means for locking them in an elevated position out of con-



CULTIVATOR.

tact with the ground, and with means for locking them in a plurality of adjusted positions intermediate their uppermost and lowermost positions. A plurality of hoes connected together is provided with means for taking up the shock incident to the change of position of the hoes. A cultivator with a plurality of wheels, forming a carriage to support the same, the wheels being adjustable relative to the frame so as to guide the cultivator

Of General Interest.

DISPLAY RACK.—T. N. FIGURES, JR., Columbia, Tenn. This rack is for use in shops or stores for displaying dry goods, gents' furnishings, or other articles. The same is preferably constructed and applied as an attachment of a show-case, it being composed of foldable and detachable parts which adapt it to be extended vertically above the show-case for use, or partly dismembered and folded on the back of the show-case in such manner as to remove it from view.

TRUSS.—L. L. BAKER, Denison, Texas. This invention refers to trusses and is particularly useful in connection with devices intended for the alleviation or cure of abdominal hernia. The aim is to provide a truss in which the pads are resiliently secured to the frame of the device. Further, to provide a truss to which may be removably secured abdominal wings, and, if necessary, a suspensory.

BALANCING TANK.—L. F. RIGOT, Milford, Pa. This inventor seeks to provide a tank suitable for use upon flying machines and the like, for carrying hydrocarbon fuel used for furnishing power for the machine, the parts being so constructed and arranged that as the liquid is gradually used up and consequently the tank becomes lighter, the center of gravity of the tank remains in its original position relatively to the framework of the machine.

EYEGLASSES.—L. B. BECKER, New York, N. Y. The purpose in this case is to provide improvements in eyeglasses, whereby the pivoted nose clips can be readily placed in position on their supporting studs or removed therefrom and interchanged with a view to locate the nose clips nearer to or farther from the bridge, as required or desired by the user.

PNEUMATIC ACTION.—HERMAN MEYER, New York, N. Y. This improvement refers to self-players, self-playing pianos and like instruments, and its object is to provide a pneumatic action having a bleed hole adjustment to permit accurate and quick regulation of the diaphragms and valves from the outside, with a view to insure proper opening and closing of the pneumatics.

AUXILIARY STOPPING DEVICE.—HERMAN MEYER, New York, N. Y. This invention relates to piano players, self-playing pianos and like instruments, and the inventor provides a device more especially designed to enable the performer to stop the motor quickly while playing and when music calls for a rest, and without the performer changing the position of the tempo lever or removing his hand therefrom.

TRADE MARK FOR A LUBRICATING OIL FOR MACHINERY.—J. A. FLEMING, Room 308, No. 328 Chestnut Street, Philadelphia, Pa. Mr. Fleming has adopted and used this trade-mark for a lubricating oil for machinery, in Class 15, oil and greases. The trade-mark is applied or affixed to bottles containing the lubricant by placing thereon a printed label on which the trade-mark is shown.

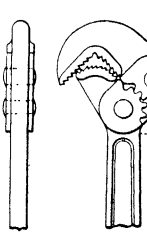
MOUSE TRAP.—J. LAQUERSTROT, New York, N. Y. An object here is to provide a means to kill the rat or mouse at the time it is caught. The trap is simply constructed and has few parts which might get out of order. It is set by opening a hinged cover, drawing a closure open against the action of a spring and holding the closure by engaging a bracket with a lever, which in turn is held by a bait holding lever.

MOLDING FLASK.—L. J. KEMPFFBERG, Easton, Pa. An object of this inventor is to provide a flask made up of a number of copes said copes being fastened together so as to form practically a unitary cope with means for fastening the cope thus made to the drag. A further object is to provide a novel form of fastening means so that the several parts of the flask may be quickly clamped together or unclamped, as occasion demands.

STUMP BURNER.—F. P. RAND, Spokane, Wash. This is an improved device for use in burning the bodies and roots of stumps both dry and green. It enables a stump to be destroyed quickly and easily without the use of any dangerous explosive, while the construction is such that it may be easily manipulated and may be produced at small cost.

Hardware and Tools.

WRENCH.—F. W. FRITCHEY, Sandusky, Ohio. This wrench has a fixed jaw and a movable jaw, the latter being so connected to the handle that when it is pulled to turn a pipe, rod or other contrivance the act of pulling not only exerts a leverage on the handle but also exerts

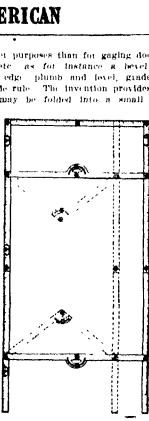


WRENCH.

a leverage action on the pivoted end of the movable jaw, causing the hold of the wrench to be tightened. The wrench is shown in side elevation in the accompanying engraving. It is simple in construction and efficient in action. It can be cheaply manufactured and is well adapted for all purposes to which tools of this description are applied.

SAW TOOL.—D. R. WILLIAMS, Whittemore, Mich. One of the objects of this inventor is to provide a simple and inexpensive saw tool by means of which the jointing or aligning of the teeth of a saw can be effected rapidly and easily, and by means of which the cleaner or raked teeth of a saw can be filed down uniformly to any desired point.

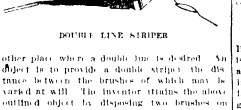
DOOR GAGE.—CARL E. ROSE, P. O. Box 194, San Diego, Cal. An object here is to provide a gage which may be extended in either direction and which is provided with means for marking the position of the hinges, etc., as for instance a bevel square, straight edge, plumb and level, grade finder, and slide rule. The invention provides a scale which may be folded into a small compass



DOOR GAGE.

when not in use, and one having a novel form of marking device. The engraving herewith represents a side view of one embodiment of the invention the level and marking device being applied thereto.

DOUBLE LINE STRIPER.—HOWARD F. KING, Somerville, Conn. This invention is illustrated herewith in a perspective view. The improvement relates to a form of double line stripers for use more particularly by carriage painters for striping the wheels and bodies of carriages, automobiles, wagons or in any



DOUBLE LINE STRIPER.

other place where a double line is desired. An object is to provide a double striper the distance between the brushes of which may be varied at will. The inventor attains the above outlined object by disposing two brushes on a support, and by means of a rack and pinion movement, separate the brushes as desired.

PLATE LIFTER.—JOSEPH F. WEYMAN, New Philadelphia, Pa. The accompanying engraving represents the plate lifter in a perspective view. The invention relates to a form of lifter or detachable handle for articles especially those which are too hot to be readily handled without the interposition of some such tool. The object is to provide a utensil having parts, which may readily be constructed from metal wire, without the use of any connecting pivots. The relative parts are so constructed

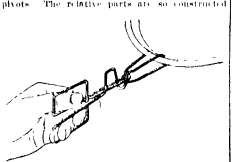


PLATE LIFTER.

that they may be mutually traced and the parts are so constructed that they may be readily and removably locked in position. In the construction each member is made continuous of one length of wire, and there are no drilled joints.

BLADE HOLDER.—PAUL R. BUCHHOLZ, care of Chattanooga Med. Co., Chattanooga, Tenn. In this instance the invention relates more particularly to a holding device for flexible



BLADE HOLDER.

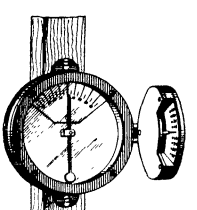
blades such as are used in safety razors. It will securely hold a blade in position for shaving or stropping. The blade is shown in the illustration herewith inserted in the holder. This is done by merely flexing it sufficiently to enter the slot and then pushing it in as far as it will go. It may be removed therefrom by pressing against the inner, upper corner, of the blade, with one finger, thereby swinging the blade outwardly above the lower corner thereof as a pivot.

Heating and Lighting.

LAMP.—F. M. EULER, Elizabeth, N. J. This invention relates to an adjustable and quick-detachable incandescing lamp. An object is to provide a lamp of any suitable type such as an incandescent lamp in which the lamp proper and in this case the bulb is adjustable to a plurality of angles whereby the light may be directed to any desired point.

Machines and Mechanical Devices.

LISTING INDICATOR.—JOSEPH ARNST, 516 North Clark Street, Chicago, Ill. The accompanying view is of an indicator constructed and arranged in accordance with the invention, the same being shown in conjunction with a stanchion for an aeroplane. The invention provides an instrument with indicators having visible scales and indicating members mov-

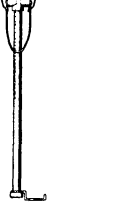


LISTING INDICATOR.

able thereover to show the lateral list of such a machine as an aeroplane and simultaneously the pitch of said aeroplane on its median transverse axis; provides an instrument the bodies of said index member being arranged in vertical planes, the last being perpendicular, and provides for the indicator being folded into compact form.

Pertaining to Vehicles.

WAGON BOX FASTENER.—HARRY F. BARR, Broken Arrow, Okla. This invention is an improvement in wagon box fasteners and its object is the provision of a simple inexpensive and easily operated device for use in holding the units of the box ready together without injury to the same which may be quickly applied or removed. The accom-



WAGON BOX FASTENER.

panying illustration shows the fastener in its front view. The device consists essentially of a pair of telescoping members or bars, each having a clamping jaw at its outer end, co-operating with the jaw of the other member and a clamp for holding the members at sections in adjusted position.

Designs.

DESIGN FOR WALL PAPER.—H. WARNE, Rixdorf, Alsace, Germany. In this ornamental design for wall paper the entire width shows a streaked effect interspersed with slightly undulating dotted lines composed of small square white dots.

DESIGN FOR AN IMAGE.—H. C. ANDERSON, Pensacola, Fla. In this ornamental design the image is a mechanism of a dog in the complete costume of hat, suit and shoes of the French court type of Louis XIV.

NOTE.—Copies of any of these patents will be furnished by the SCIENTIFIC AMERICAN for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

Notes and Queries.

Kindly keep your queries on separate sheets of paper when corresponding about such matters as patents, subscriptions, books, etc. This will greatly facilitate answering your questions as in many cases they have to be referred to experts. The full name and address should be given on every sheet. No publication will be paid to unsigned queries. Full hints to correspondents are printed from time to time and will be mailed on request.

(12561) W E W Y says On the evening of September 7th, at 7 30 o'clock, there appeared a beautiful lunar rainbow in the western heavens. At about 7 P M a dark cloud arose in the west, and rain fell heavily for some minutes. It was perfectly clear in the east, and the full moon, coming up from the under world shot its rays through the rain drops with the result of a gorgeous rainbow at night. This is the first time a phenomenon of the sort has been observed here, so far as investigation discloses. Are there many instances of lunar rainbows on record? A Lunar rainbows are not a frequent occurrence. This one seems to have been unusually brilliant. Generally but a few colors are seen. The moon on September 7th was within one day of the full, and hence gave almost the maximum of light. This would account for the brightness of this lunar bow. The noted geologist Edward Hitchcock, formerly president of Amherst College, Massachusetts, once said in an address, "He who has seen one total eclipse of the sun or one transit of a planet over the sun, or one November shower of meteors or one spectral comet, or one lunar iris or one volcanic eruption, may be satisfied and cannot hope for a second sight." The writer of this note has seen all of these grand phenomena of nature, excepting a meteor shower of the first rank and a great volcanic eruption but he has had the privilege of seeing a lunar iris on two occasions and has seen volcanoes in action and many smaller meteor showers. The geologist was right in his list of rare natural phenomena.

(12562) F R K says I desire to copper plate glass plates 20 inches by 26 inches for use as a condenser in wireless telegraphy. Will you please give some method of coating the glass to render it a conductor, and also give voltage necessary? A glass may be prepared for copper-plating by giving it a coat of copal varnish or of gutta percha in benzole. When this is dry it will take plumbago in the ordinary way. Copper plating with an acid bath requires from 0.5 to 1.5 volts. With a cyanide bath 2 to 5 volts are needed. Various processes and formulæ will be found in Watt's "Electro Plating," price $4.50. It would seem necessary to have some good manual at hand for the numerous details of the work. It would be much easier for a novice to coat the glass with silver, as in a mirror. This process is fully described in our SUPPLEMENT 1071, price ten cents. The silver surface would be just as effective as a copper coating. The silver could be plated with copper. It might be the easiest way to obtain a base for the copper plating to deposit a thin coating of silver on the glass and plate the copper upon that.

(12563) W A S asks Have you a STATEMENT that will give detailed information in regard to magnetizing magnets such as are commonly used on such magnetos as are used for gas engine ignition? A Unless one has a practical knowledge of electricity at his disposal, it would be better to send magnets away to be magnetized. The process however is simple. A coil of wire should be made of such size that it will slip over the magnets so that the magnets may be passed through the coil. No. 16 B & S single cotton covered copper magnet wire may be used and 100 turns will be sufficient. Wind in concentric layers passing back and forth. This will make a coil about an inch and a half long and less than a half inch deep. If much be permanent use. It should be well filled with turns and should be for taking it from the form or wound upon which it has been wound. It should also be secured from unwinding, by binding it with fine cord. This coil will stand the passage of one or more little time without overheating. For most convenient use it may be connected in series with an electric motor circuit. It cannot be connected directly to lighting circuit its resistance is too small and coil would get hot in a few seconds or the fuses would be melted out. Pass the current to be charged through this coil every time. A small current will give you the polarity of the coil and magnet.

(12564) A D asks Can you give me a formula to make a solution to do electro silver plating with wet batteries. A A solution for silver plating may be made by obtaining 3 ounces of silver chloride and 6 to 12 ounces of potassium cyanide per gallon of water. The mode of preparation and the care of the bath are fully given in Van Horne's "Modern Electroplating," which we will send for $1. It is quite as important to keep the bath in good condition as it is to have it right at the outset.

NEW BOOKS, ETC.

YELLOW FEVER AND ITS PREVENTION. A Manual for Medical Students and Practitioners By Sir Rubert W. Boyce, M.B., F.R.S. New York. E. P. Dutton & Co. 1911 8vo; 380 pp., illustrated Price, $3.50 net.

The distinguished author of "Yellow Fever and its Prevention" has had exceptional opportunities for the observation of this scourge in New Orleans, Central America, the West Indies and Africa. His high standing in pathology and tropical medicine gives the volume an authority which no student or practitioner can afford to ignore. Many will recall his previous work, "Health Progress and Administration in the West Indies," in which was sketched the history of yellow fever in the West Indies and Central America. The present work deals more particularly with the scourge as observed in West Africa, although its general history and geographical distribution are first given. In succeeding divisions the disease is discussed from the viewpoints of symptomatology and treatment, pathology, epidemiology, and entomology, while not the least interesting and perhaps the most practical division is the closing one, under the head of prophylaxis. In this division a successful plan of campaign is drawn, which includes prompt official notification of the danger, the enforced retirement of non-immunes to a place of safety, and the attack upon the breeding grounds of the *Stegomyia*, the evacuation and fumigation of infected bungalows and the perforation of gutters. Plates, maps and five charts elucidate the text and add materially to its value.

GAS ENGINES By W J Marshall and Capt H Riall Sankey, R E New York D Van Nostrand Company, 1911 8vo, 278 pp., Illustrated Price, $2 net

"Gas Engines" is addressed primarily, not to designers and manufacturers, but to purchasers and users, that they may gain a better understanding of the possibilities and peculiarities of the internal-combustion engine and so secure more satisfaction and profit in its use. The intending purchaser is given information that will guard him against impossible claims for power and economy. The theory of the subject is carefully set forth, with the fundamental principles of its thermo-dynamics. The descriptions of typical cycles are accompanied by that wealth of illustration which is absolutely necessary to thorough instruction in any complicated device. The operation of the engine is given the space and consideration worthy of its importance. Gas and gas producers form the subject of the final chapter. The work is a very condensed and satisfactory presentation of a subject of universal interest.

MATHEMATICS FOR THE PRACTICAL MAN By George Howe, M E New York D Van Nostrand Company, 1911 12mo; 143 pp. Price, $1.25 net

The author has been impressed by the scarcity of published courses in the fundamentals of mathematics, and the tendency of these courses to treat the subject in a popular rather than a scientific way. The attendance of night schools is made up of such diverse bodies of men, of such varying degrees of training or lack of training that instruction must always begin with studies adapted to the lowest number of the students. The textbook in hand is designed to meet the requirements of night classes in that it begins at the beginning, assumes no mathematical knowledge beyond arithmetic on the part of the student, and strives to eliminate the vagueness and diffuseness of the average elementary work. It contains the fundamentals of algebra, the first principles of trigonometry, logarithms and the elementary principles of coordinate geometry and of the calculus.

LES LOIS EXPERIMENTALES DE L'AVIATION Par M. Alexandre Sée, Ancien Elève de l'Ecole Polytechnique Paris Librairie Aéronautique, 1911 8vo, 348 pp., Illustrated

M. Sée's papers constitute a thoughtful and well arranged presentation of the laws governing the science of flight. The five divisions of the work are "The Laws of Air Resistance," "The Theory of the Aeroplane," "The Flight of Birds," "A Study of the Propeller," and "The Problem of Stability." The conclusions at which the author arrives, and the expression of these conclusions in principles and equations, occupy far too much space to be summarized here. But the work will well repay study, and should be in the library of all experimenters. It is characterized by its Parisian reviewers as a remarkably clear and complete exposition of flight and the laws by which flight is governed.

RAND-MCNALLY OFFICIAL INDEXED POCKET MAPS AND SHIPPERS' GUIDES New York Rand, McNally & Co., 1911. Price, 25 cents each

We are in receipt of the following pocket maps and guides: Alberta, Colorado, Florida, Illinois, Indiana, Manitoba, Massachusetts, Mexico, Michigan, Minnesota, Newfoundland, New Jersey, New York, Ohio, Oregon, Saskatchewan, Texas and Washington. These are detailed and very legible maps showing the steam railroads and proposed extensions, with all stations and junctions plainly indicated. Electric roads are given in red. The new divisions and boundary lines, and the new post offices and express offices, are entered. Population, based upon the figures of the latest Census, is given for every city and village. Shippers, travelers, Civil Service students and others will continue to appreciate the cheap and handy form of this up-to-date information as they have done in the past.

ELECTROPLATING. By Henry C. Roets. Chicago: Popular Mechanics Company, 1911. 12mo.; 99 pp.; Illustrated. Price, 25 cents.

This treatise describes the process of electroplating and tells how to make a small outfit with a glass fruit jar and a wet battery. The more advanced phases of the subject are also entered, with a description of shop equipment and specific directions for nickelplating, silverplating, and goldplating, and a chapter of suggestions that may aid in establishing the beginner upon a business basis.

THE WHISTLER BOOK. A MONOGRAPH OF THE LIFE AND POSITION IN ART OF JAMES MCNEILL WHISTLER. Together with a Careful Study of his more Important Works. By Sadakichi Hartmann. Boston. L. C. Page & Co., Inc., 1910. 12mo.; 272 pp

The art of Whistler is very much in the public eye in this country at the present time owing to the remarkable Whistler exhibition which was held last year in the Metropolitan Museum. The writer is admirably equipped to perform most difficult task. The illustrations are admirably chosen and are beautifully executed, being printed on coated paper, the illustrations are inserted. Like all the books in this series, it is beautifully printed and bound.

WOOD-WORKING FOR AMATEUR CRAFTSMEN. By Ira S. Griffith. A.B. Chicago Popular Mechanics Company, 1911. 12mo.; 121 pp., Illustrated Price, 25 cents

The student first taught the care of tools, the laying out of rough stock, and the uses of the plane and the saw. Several simple objects are then pictured, such as a bird box an umbrella stand a table, a cabinet and in taking the beginner through the details of their construction further knowledge of the handling of tools and material is easily and naturally imparted.

THE BOSTON MUSEUM OF FINE ARTS By Julia DeWolf Addison Boston L. C. Page & Co., Inc., 1910 12mo., 454 pp.

The present work gives a descriptive and critical account of the treasures of the Boston Museum of Fine Arts which represent the arts and crafts of remote antiquity to the present time. A work of this kind is of the greatest possible value, as it can be taken right into the gallery, where it serves as an amplified catalogue to the collections in the Boston Museum of Fine Arts are too well known to call for any praise. The collection has been admirably made and is admirably housed particularly in the new buildings. The illustrations in the book are widely selected and are beautifully reproduced and printed. Like all the books of this publisher, it is an excellent piece of book making and is attractively bound.

MOLDING CONCRETE CHIMNEYS, SLATE AND TILE ROOFING By A. Houghton New York The Norman W Henley Publishing Company, 1911. 61 pp Price, 50 cents

This handbook is No 4 of the series, and is explanatory of the ways in which roof tiling and chimneys are manufactured of concrete. The text is fully illustrated by original drawings, and in this, as in the other numbers of the series, a feature is made of easily consulted models. The factor of safety has been steadily kept in mind.

MOLDING AND CURING ORNAMENTAL CONCRETE By A A Houghton New York The Norman W Henley Publishing Company, 1911 58 pp Price, 50 cents

This No. 5 of the "Concrete Workers" series, tells the proper proportions of cement and aggregates for different finishes, with the methods of mixing and placing in the molds, and of curing and remedying defects in the finished work. Also the manner of coating the molds with non adhesive compound to prevent the concrete from sticking to the molds.

TRAIN RULE EXAMINATIONS MADE EASY By G. E. Collingwood New York: The Norman W Henley Publishing Company, 1911 19mo; 234 pp. Price, $1.25

PRACTICAL INSTRUCTOR AND REFERENCE BOOK FOR LOCOMOTIVE FIREMEN AND ENGINEERS By Charles F. Lockhart New York The Norman W. Henley Publishing Company, 1911 12mo.; 362 pp Price, $1.50.

UP-TO-DATE AIR-BRAKE CATECHISM. By Robert H Blackall New York: The Norman W Henley Publishing Company, 1911 12mo.; 362 pp Price, $2.

These three books are of the practical kind that will appeal to men who are actually engaged in railroading. Mr Blackall's "Air-Brake Catechism," which has long been a standard work, describes the air-brake equipment and how it is operated. Mr Lockhart's book is a text book for locomotive engineers and firemen. Mr. Collingwood's book is in the nature of a quiz, and follows the question and answer method. The three books may be recommended for giving a vast amount of information in a very compact form.

ISOMERIC SETS. By Dr. Charles Frederick Bolduan. New York: John Wiley & Sons, 1911. 238 pp. Price, $1.50.

It is probably safe to say that in the scientific world there are few subjects of greater importance, as far as the great public is concerned, than that of the bacteriological treatment of diseases. The advances made in this field, particularly during the past few years, have been greater, or at least as great as, those in any other field of research. Naturally a subject which touches the well-being of the race so closely as this has provoked a widespread interest, not merely in the medical profession, but throughout every walk of life. Because of the highly scientific character of the investigations and achievements of the bacteriologist, his work is not easily explained, and is difficult of understanding, not merely by the average citizen, but even by many practitioners who are greatly occupied time prevents them from keeping in close touch with the progress which has been made. Consequently, there has been a call for a work on the subject which would be accurate, simple and concise, yet sufficiently comprehensive as a clear understanding of what has been done and of the reasonable expectations of future progress.

In the work under review, Dr Bolduan appears to have successfully met this need. The present volume is the fourth edition of the work which first appeared in 1904, and which dealt only with certain anti-bodies, whose discovery had aroused a great deal of scientific interest. To this was added in subsequent editions a discussion of anti-toxins, agglutinins, opsonins, all of which were naturally embraced under the title "Immune Sera." In the present edition the scope of the subject matter has been widely extended, and the work contains a clear exposition of the main facts of infection and immunity. Every one who has been sufficiently interested to read even cursorily the broader literature on this subject is familiar with the side-chain theory of Ehrlich, which of late years has dominated the investigations in this particular field. While admitting the value of Ehrlich's work, the author considers that some of the deductions from his theory have led to conclusions which are opposed to plain established biological facts. Therefore, in giving a lengthy presentation of Ehrlich's views, he makes it clear just why and wherein other investigators have differed from him. Of particular interest at the present time is a chapter dealing with the principles underlying the treatment of syphilis with Salvarsan, or 606, as it is popularly called. The value of this drug is now generally conceded, and leads one to hope that further work along similar lines will sooner or later bring to light specific therapeutic agents in other diseases.

Those of our readers who have followed the newer conceptions of physical chemistry will be interested to see how quickly and extensively these have been taken up by the workers in this fascinating department of medicine.

Dr. Bolduan has succeeded in fulfilling the aim of this work, which is to present a lucid, clear outline of the main facts and theories concerning infection and immunity. An excellent feature of the book is the fact that it is presented in clear, concise, and forceful English that is not overburdened with technical phraseology.

THEORIE PHYSICO-CHIMIQUE DE LA VIE ET GENERATIONS SPONTANEES By Stéphane Leduc Paris: A Poinat, 1910. 8vo; paper

In the introduction to his remarkable book, Prof. Leduc states that the essential phenomenon of life is nutrition. If food is to be assimilated, it must be introduced in the liquid state; hence the elementary phenomenon of life is the contact between alimentary liquids and living substances, and the knowledge of life is subordinated to the knowledge of the physico-chemico phenomena which result from the contact of different liquids. Biology, in Prof. Leduc's opinion, is destined to be a part of the physical chemistry of liquids. The physical chemistry of life, therefore, comprises a study of all non-electrolytic solutions and electrolytic solutions, of colloidal solutions, of molecular forces at play in these solutions, osmotic pressure, crystallization, and the phenomena produced by such forces as diffusion and osmosis.

THE TENNESSEE SHAD. By Owen Johnson. New York: The Baker & Taylor Company 12mo.; 310 pp.; Illustrated. Price, $1.20 net.

When Owen Johnson's "The Varmint" first immortalised the American preparatory school as a few classics had immortalised the so-called "public schools" of England, nor the least inspired episode was that of the Tennessee Shad's "sleep prolonger" and its exploitation by Doc Macknoder. Doc, it will be remembered, so skillfully engineered the financial end of the business as to divert to himself all the profits of the enterprise. In this later story the Tennessee Shad's imagination continues to efferesce, and the development of Macknoder's business instincts is calculated to make a pall-bearer chuckle. Johnson's boarding of school themes is delicious and intimitable.

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Frank Julian Sprague

(Concluded from page 365.)

Sprague developed the high-speed screw elevator, the automatic house elevator, the double motor drum elevator and other devices.

While all this was going on Mr. Sprague had offered to run the Manhattan Elevated Railway electrically, but having to deal with progressives of the type of Gould and Sage, he did not get very far. Turning his efforts to Chicago, he there put into service on the South Side Elevated his "multiple unit" system, under forfeiture contract. Once more he made good, with startling results, so that not only in Chicago, for elevated railway work, the multiple unit system is the only one known, but it is the sole dependence of the roads in New York and Boston. Then came the Manhattan Subways, and all the river tube systems—every one an example of multiple unit application.

Mr. Sprague's fundamental and basic patent on this contains nearly 300 claims, a good multiple unit in itself, and a fair exhibition of reticence on the part of a man who would rather talk and fight and invent any time than listen to music and the drama—though he dotes on both.

Of course such an inventor and engineer was early drawn into the work of changing over for electricity the big terminals of the trunk railroads, and hence he is found on the consulting staff of the New York Central. He was also retained by Harriman as to similar work on the Southern Pacific. In these developments he has been understood to stand strongly for the use of the direct current, against the alternating, as used on the New Haven road, but at the same time he has advocated hitting up the potential for direct current work, and has jumped it from 600 to 1,200 volts, with very satisfactory results. He has also been a stout advocate of the protection of the third rail, with devices exemplified on the New York Central and several other roads. More lately, Mr. Sprague has returned to the subway problem, by tongue and pen has advocated reforms and improvements, and has even offered to undertake, with full financial responsibility, the construction needed to relieve the frightful congestion on the older lines.

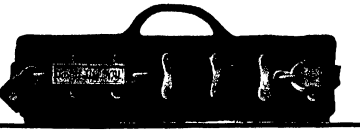
There is not much of Sprague to look at, but it is all fighting weight, nerve, grit, go, snap and confidence. He has crossed the 50 line, but does not suspect it; and the dark hair, flashing eye, equiline nose, sharply-cut chin, alertness of movement, tenseness of poise, all tell of a very live human being. He has an acutely mathematical mind, tempered, fortunately, by humor and imagination, but he is concentrated, and no matter what you may want to talk about, has no difficulty whatever in swinging the conversation back to the thing he is interested in. A more loyal and generous friend could not be imagined, but there are some persons he will omit from his will. To this day he maintains the keenest interest in the profession of his early years, and his appointment as visitor to the Naval Academy is still regarded by many conservatives as perhaps the saving feature of the Roosevelt administration.

Relative Strength of Italian and Turkish Navies

(Concluded from page 371.)

Of less important cruisers of the protected type Italy possesses ten, of from 2,250 to 3,500 tons, and from 17 to 20 knots speed. Their armament consists generally of from four to six 4·7-inch or 6-inch rapid fire guns. The navy includes two 23-knot torpedo cruisers and eight gunboats, the latter fitted for laying mines. The torpedo fleet is made up of twenty-three destroyers, of 28 to 30 knots speed and about 350 tons displacement. Also twelve destroyers of 620 tons and 30 knot speed are under construction. The torpedo fleet also includes eighty-one completed torpedo boats and thirty under construction. In the submarine flotilla are the "Delfino," 107 tons, 6 and 9 knots, the five "Glaucos," 160 tons, 9 and 14 knots, the "Foca," 280 tons, 9 and 15 knots, and eleven vessels under construction or about to be commenced.

At the present writing no engagements of any importance appear to have taken



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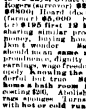
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place between the two navies, and it is not likely even in the event of a protracted war, that the struggle will shed much light upon the leading naval problems of construction, tactics and strategy

Small Isolated Electric Power Plants

(Concluded from page 874.)

main battery Each cell may consist simply of two plates of sheet lead suspended in a jar of electrolyte.

At *W* is indicated a variable resistance which must be used during the process of forming the home-made battery previously described This will need to have a resistance of about seven ohms and a current-carrying capacity of six amperes

When the switch, *S*, is closed to the left it connects the battery directly to the load through the upper blade The lower switch point is not used for anything on this side, but its clip makes a most convenient place to keep a spare eight-ampere fuse When it is desired to charge the battery the dynamo is started, and, by manipulation of the field regulator, *R*, is brought up to a voltage sufficient to light the lamp, 1, to about half its candle power The switch is then thrown to the right, connecting the battery to the dynamo through the upper blade, and both battery and dynamo together to the load through the lower blade and the three c e m f cells The charging of the battery may be done during the day or at night, as may be most convenient

When fully charged, a 36 ampere-hour battery will run seven 16 candle-power lamps for eight hours, and it will require a current of five amperes for eight hours for the recharge Assuming an average evening's use of four lamps for 3½ hours it should suffice to charge the battery twice a week In winter, when the evenings are long, it may need to be charged every other day On occasions of unusual demand, such as parties or receptions, to prevent the battery being exhausted too rapidly, it is necessary for the dynamo to be run in the evening to carry a part of the load The same thing is true in cases where it is desired to use an electric flat-iron or vacuum cleaner, which easily can be done by keeping the dynamo going all day on "ironing day" and "cleaning day"

The foregoing specifications, as stated in the beginning, apply to a small sized installation where lighting is the principal requirement Before installing a 32 volt plant, careful consideration should be given to the subject of future extensions Electric cooking and other heating appliances, motors and the like not only require a larger plant to run them, but it is desirable to operate them at a higher voltage in order to keep down the size of the copper conductors necessary to carry the large currents imposed by low voltage For larger plants sixty volts has been adopted as a standard, and makers of lamps, heating appliances, etc., now carry these in stock made for this voltage The following specifications will give a good idea of what is needed for a 60 volt plant

Battery, 30 cells two-plate type 36 ampere-hours capacity and 6 c e. m f cells, or 60 cells of the home-made battery, connected thirty in series and two in multiple, with 6 c e m f cells all in series

Generator, shunt wound dynamo 77 volts, 5 amperes, speed about 2,000 r. p m

Engine, one horse-power

Ammeter, 10-0-10 scale; voltmeter, 80 volt scale

This outfit will have twice the capacity of the one previously described. It would be suitable for a connected load of forty 16 c p lamps where the maximum demand is limited to twenty-five. The battery alone will be large enough to handle light intermittent loads through the day, such as coffee-percolator electric toaster, or a one-half horse-power pump motor for the house tank supply This outfit is adapted for future enlargement by the addition of more battery, but if this is anticipated in the very beginning it would be better to install a larger charging equipment—say a 3 horse-power engine with a 77 volt 10 ampere dynamo, and to have the ammeter scale marked 30-0-20.

The Electrical Show in the New Grand Central Palace

THE New York Electrical Show, this year, was used to open the new Grand Central Palace, located on Lexington Avenue, between 46th and 47th streets. This handsome structure was brilliant with myriads of electric lights, which were reflected with great brilliancy by the white walls of the interior At the top of the building on the outside the arched gallery was illuminated with mercury vapor lamps, the bluish light of which gave a soft, delicate effect when viewed from a distance in the light of the full hunter's moon

Several of the large electric companies have excellent exhibits of all kinds of household electrical apparatus Along the south side of the building there is a row of rooms illustrating the equipment of a modern house from kitchen to bedroom In the former room there is an electrical washer, a churn, a chopping machine, and a full equipment of cooking utensils, while in the bedroom there is an electric massage instrument, a miniature hair-drying fan, an electrical-operated sewing machine, etc The company also has a complete electrically operated printing plant along the west side of the building A small paper is printed every day, giving the latest news, many of the despatches being received by wireless.

A particularly interesting display was the historical exhibit in the gallery This consisted of old books dating back to the time of Franklin, and various electrical apparatus The most interesting feature, perhaps, of this exhibit was the development of the arc lamps, from the original Brush twin-carbon lamp, to the flaming arc lamp of the present day

Storage batteries and electric automobiles occupy a considerable part of the floor space, there being exhibits by the Edison Exide, and Gould storage battery firms, as well as electric automobiles of most of the leading makes The recent record of 110·9 miles made on the Ocean Boulevard between Brooklyn and Coney Island by a Fritchle electric car, carrying four people, which was made with a lead battery, has been exceeded under actual touring conditions by the Edison battery, which, about a year ago, received a thorough testing under Edison's supervision, in pleasure vehicles Some time after, a run of 244½ miles at the rate of 12 miles an hour, was made with a Baker electric auto on city streets in Cleveland, with a 40-cell 225-ampere-hour Edison battery This is the record for tests of the kind just mentioned, while *for touring purposes*, from 125 to 150 miles, it is claimed, can be made on one charge Plates taken from a cell which has been in continuous use in delivery service in New York city for two and one-third years, and which has run a delivery wagon 25,000 miles, were exhibited and showed no depreciation. The capacity of these cells is said to have risen from 225 to 300 ampere hours after this long-continued use In addition to this increase of capacity with use, the Edison battery has the advantage that it can be charged whenever convenient, and is not ruined if left standing in a discharged condition. The Electric Storage Battery Company also exhibited vehicles and stationary cells.

A barber shop equipped with all the latest electrical appliances, was located in the middle of the main floor, while on a raised platform above there was exhibited a novel combined electric piano and violin orchestra Three violins were mounted upside down in a circle above the piano, and were played by means of a revolving ring, rotated at various speeds in producing different notes. Whenever a note was struck on a violin, the instrument was moved about its neck as a pivot until the strings contacted with the ring Meanwhile, electrically-operated levers fingered the strings The music produced by this orchestra was excellent nd the amount of expression secured was surprising.

As a whole, the show this year is made up of small apparatus There are none of the big motors and generating sets that have sometimes been exhibited when the show was held in Madison Square



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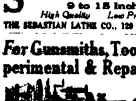


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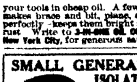
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Garden. The myriad uses of electricity in the home and office, however, have never been so well illustrated as now, and this alone, together with the historical exhibit, makes the show interesting to laymen

The Glidden Tour and the Fairmount Park Automobile Race

MORE than fourscore automobiles started in the 1911 Glidden tour from New York city on October 14th The route this year extends 1,456 miles from New York to Jacksonville, Florida The trophy will be contested for by teams, the team having the best average of prompt arrivals being the winner There are various divisions for runabouts and touring cars, besides which there are several three-wheeled motorettes and a number of trucks and baggage cars It is expected that the 1911 tour will be the most successful of any held thus far, as the roads of the South have been greatly improved during the last few years, which should assure the motorists an enjoyable trip

On October 9th, there was held in Fairmount Park, Philadelphia, the automobile race for fast cars, that has been run annually for the past several years This race was notable for the fact that there were no accidents of any sort, and yet the speed records were broken, principally by amateur drivers. The winner of the race was Erwin Bergdoll, in a 90-horse-power Benz His time was 3.18 41.35—an average of 61.25 miles an hour He beat by 10 minutes 26.53 seconds the time of Zengel, in a Chadwick car last year In fact, no less than six of the nine cars that finished this 202½ mile race, beat the time of the winner last year, which was 3 39 07.88 Spencer Wishhart, in a Mercedes, secured second place in 3.20.11.42 He held the lead for three laps, but was finally outdistanced. Ralph Mulford, in a Lozier, obtained third place His time was 3.21.52.78 He stood a good chance of coming in second, but was obliged to stop for gasoline and oil near the end of the race, and in so doing lost his position Last year Mulford finished but six seconds behind the winner.

Mr Bergdoll beat the best record for one lap no less than six times, besides equaling it once during the race The time of 7.36 for the 83-mile lap, made by Harround in a Marmon car last year, was reduced to 7 minutes and 28 seconds by this amateur racing driver. Several other well-known automobile racing men finished in the remaining places Zengel, in a National, was fourth, and Disbrow, also in a National, was fifth, while Harry F Grant, twice the winner of the Vanderbilt cup race, was sixth A small car the Mercer, obtained seventh place in 3.29 45⅗ This race was particularly interesting from the fact that the first and second places were won by amateurs The next big race of this kind will be held at Santa Monica, Cal., shortly

Repairing Old Bridges by Injecting Cement

AT Hamburg there are two bridges the masonry of which was threatening to fall in ruins, being traversed by innumerable cracks of varying size A rather remarkable process has just been made use of to rejuvenate these bridges. A number of holes were bored throughout the structure so as to give access to the interior, and cement was injected by pumps under pressure Reports on the present condition of the two bridges thus treated are entirely favorable.—*La Nature.*

Correspondence

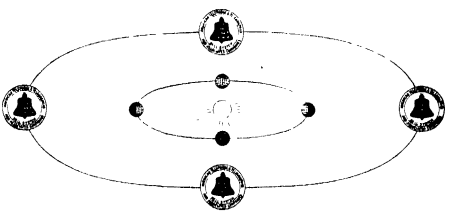
[The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.]

The Harvest Moon

To the Editor of SCIENTIFIC AMERICAN.

I beg to call your attention to Fig. 7, illustrating my recent article, "The Harvest Moon" My drawing showed the illuminated hemisphere on the left. Of course, I see how it happened, but it is misleading. FREDERIC R. HONEY.

Hartford, Conn.



Comparison of the Distance Traveled by Earth and Bell Telephone Messages

The Orbit of Universal Service

In one year the earth on its orbit around the sun travels 584,000,000 miles; in the same time telephone messages travel 23,600,000,000 miles over the pathways provided by the Bell system. That means that the 7,175,000,000 Bell conversations cover a distance forty times that traveled by the earth.

When it is considered that each telephone connection includes replies as well as messages, the mileage of talk becomes even greater.

These aggregate distances, which exceed in their total the limits of the Solar system, are actually confined within the boundaries of the United States. They show the progress that has been made towards universal service and the intensive intercommunication between 90,000,000 people

No such mileage of talk could be possible in such a limited area were it not that each telephone is the center of one universal system.

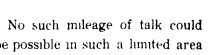
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INVENTORS' NUMBER

NOVEMBER MAGAZINE NUMBER of the SCIENTIFIC AMERICAN

ISSUE OF NOVEMBER 18th, 1911

Although every number of the Scientific American discusses the inventions and inventors of the day, there will be published on November 18th a mid-month magazine number which will display the inventor in a new light. Articles will be published which will show how much he suffers from our antiquated legal system and will explain his need of sympathetic governmental support. His foibles, too, will not escape notice.

There will be an arraignment by Mr. Melville Church of our marvelously complicated method of trying patent infringement suits. Mr. Church is one of the most eminent patent lawyers in this country, a man who has figured prominently in some of the most important patent cases that have been tried in this country. He points out what a burden is imposed by the present method of taking testimony in chambers without any Court supervision and how enormously expensive a trial may be before the infringer is successfully brought to book. We need only mention the scores of volumes of printed testimony taken during the trial involving the validity of the Selden patents, to drive home the utter absurdity of our Court procedure. The inventor who has suffered because of the slowness of our judicial machinery will read Mr. Church's article with interest and profit, for he will learn what steps are being taken to protect without impoverishing him.

The great industrial corporation (the "Trust" of whom we have been hearing so much of late) has changed the aspect of invention. It now pays to invent thousands of little feeding devices, thousands of little trains of gears and levers and cams, which, fifty years ago, might not have proved so profitable. An invention that means a saving of one cent per ton in the handling of raw material becomes of industrial importance for the simple reason that the "Trust" deals in gigantic masses. In an article entitled "The Industrial Corporation and the Inventor" this aspect of modern invention is treated.

Fascinating is the story of making big fortunes out of patents on small and apparently unimportant things. Every time anybody in the United States pulls the cap off a beer bottle or a soda water bottle, he puts the fraction of a cent into the pockets of a Baltimore inventor. Elias Howe, who first made the sewing machine practical by placing the eye of the needle near the point, admitted that he had collected $1,185,000 in royalties. The man who invented ingrain carpet with the threads so interwoven as to prevent wrinkling, is now better off by $4,000,000 for his thought. A government clerk named McGill found it hard to hold together many pages of thick documents. He got over the difficulty by inventing the little brass paper fasteners which we all use. He died rich. His invention made money. These are but a few of the facts taken from a striking article by Mr. William Atherton DuPuy on the big fortunes that have been made on little inventions.

Perpetual motion is the inventor's Will-o'-the-Wisp. In the Inventors' number will be found an article in which the various forms of perpetual motion apparatus that have engaged the attention of dreamers for years are explained and their fallacies set forth.

There is a funny side to invention as the Inventors' Number will tell you. What possible use could there be in encouraging birds to infest the farmer's grain fields by providing fence posts with birds' nests in them? Or of table knives with mirrors in the handles to permit the users to inspect their teeth now and then? Or of a telescopic anti-collision pilot for railway trains running in advance of the locomotive and bearing an automaton that rings a loud gong? These and even more ridiculous inventions will be described in the article on "The Funny Side of Invention."

In addition to these articles, there will be the usual Scientific American material—the articles on current scientific discoveries, the Department of Curiosities of Science, the Science Abstracts and the rest.

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VOLUME CV.] NEW YORK, OCTOBER 28, 1911 [10 CENTS A COPY $3 00 A YEAR

ARTPUSA



When the target comes within the field of the telescope, a bomb is released, and it falls upon the target, describing a parabolic curve due to gravity and velocity of the aeroplane.

DROPPING BOMBS FROM FLYING MACHINES.—[See page 388.]

SCIENTIFIC AMERICAN

Founded 1845

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The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are sharp, the articles short and the facts authentic the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

The purpose of this journal is to record accurately, simply, and interestingly, the world's progress in scientific knowledge and industrial achievement.

The Spirit of the Coliseum

A CERTAIN number among the multitudes that poured into the Coliseum in the days of ancient Rome were drawn thither solely by the true sporting instinct, which delights in witnessing feats of skill and endurance. The large majority went to witness the spilling of blood, for even the noble Roman matrons, we are told, in response to the inquiring glance of the victorious gladiator, would turn their thumbs down, indicating that they wished to see the life blood of the vanquished redden the sands of the arena.

Can it be possible that a touch of the savage desire to look upon mangled bodies and hear the sob of expiring life, which slumbered beneath the superficial civilization of the Roman people, is responsible for the vast crowds which gather at our modern race tracks to witness the criminally dangerous automobile race, or watch the aviator straining for a fall with Death, a thousand feet in midair?

There was a time when the automobile race, run over the highways of the country, possessed a distinct scientific and technical value. The supreme test of the strength and endurance of materials which was afforded by those contests, was one of the most valuable factors in bringing the automobile to its present perfection, and the brave fellows who lost their lives may be considered as having been sacrificed in a just cause, since they rendered possible the rapid advancement of a new means of transportation—possibly the most valuable that was ever introduced.

To-day, however, any legitimate reason for the holding of automobile races, particularly on dangerous race tracks, has disappeared. That such races, in spite of their frequent and frightful fatalities, continue to be held is to be explained by the co-operation of what Mr. Roosevelt has recently denominated as "commercialism and hysteria." If the possibilities of sudden death or horrible wounding were eliminated from these exhibitions, we venture to say that the promoters who, to us, on this morbid taste on the part of the public would quickly find that such exhibitions were altogether unprofitable. The element of novelty has long ago passed from such contests. Every one knows that if 200 horse-power is crammed into a racing automobile the machine will skid around an ordinary race track at a speed of something under 50 seconds to the mile, and every one knows also that a crowd of twenty to thirty high-powered racing machines will average on a specially-prepared track over seventy miles an hour. Should the time ever come when tires no longer burst, nor steering gears give way, nor roaring monsters go hurtling through a crowded mass of humanity at the rail, we venture to say that automobile racing is a sport will be as dead as croquet or shuttlecock and battledore.

The same argument holds as regards many of the so-called aviation meets. Continuous flying around a circular or oval course is monotonous. The public demands the spectacular in the form of "dives," "spirals," and other aerial gymnastics that are performed at imminent peril to life and limb. How often during the past year has the unfortunate aviator launched himself into the air under atmospheric conditions which he knew to be more than perilous—being driven to it by the jeers of a crowded grand stand and the importunities or threats of a professional promoter or the "local committee" of a bill-placarded and expectant city. The death of an aviator under such conditions comes very near to being homicide of the most atrocious character.

Let it be understood that the SCIENTIFIC AMERICAN is now speaking of so-called "aeroplane meets" which are exploited purely for commercial gain. Such gatherings as were held last year at Belmont Park, in which the pick of the aviators of the world contested, and where everything that could be done was done to satisfy the public and at the same time safeguard the contesting aviators, fulfill a useful purpose. They encourage the art as the automobile contests of eight to ten years ago served to develop the automobile and build up a great industry. Of even greater value are well-organized cross-country races. We venture to say that the art of aviation receives more stimulus from such a flight as that of Atwood from St. Louis to New York, or the present remarkable and so far successful attempt of Rodgers to fly from the Atlantic to the Pacific, than it does from a whole season of the present irresponsible aeroplane exhibitions, with their shocking list of fatalities.

The Scrap Heap

ONE of the most marked distinctions between American and European practice in the technical arts is the free use (amounting in foreign eyes to positive extravagance) which we make of the scrap heap. Possibly the difference is due to the much greater cost of labor in this country; but whatever the cause, the fact remains that whereas in Europe there is a tendency to repair, rebuild or even largely re-design existing machinery, in the effort to keep it upon its legs as long as possible, here in America it frequently happens that a comparatively recent installation of costly machinery will be torn out and sent to the junk pile, to make way for an entirely new plant embodying the latest improvements.

We do not have to go far to find cases in point. Many of us will recollect the pride with which it was stated in the English press a few years ago that such and such a locomotive had recently left the railroad shops, after a thorough overhaul, and was again in service, with a record of Heaven knows how many decades of continuous service behind it, during which it had covered some millions of miles of track. Now to American eyes, although such a fact speaks volumes for the well-known excellence of British workmanship, the mere existence of a forty or fifty-year-old engine in service indicates that conservatism is being carried too far, and that English railroad methods lack that flexibility which is necessary for the best results. Perhaps the value of the scrap heap has never been shown to better effect than among American railroads and in those vast industrial plants and organizations which are covered by the steel trade. Where one enormous locomotive can be made to do the work of two, our railroad men never hesitate to discard the smaller in favor of the bigger unit, and instances have not been wanting where, in the manufacture of steel, a vast and costly plant has been "scrapped" to make way for some improved machinery, which, by virtue of its reduction of labor costs and general speeding up of the process, gave sure promise of not only paying for the discarded plant but producing the manufactured product at a lower cost.

It is agreeably to this policy that certain older ships of our navy are put up for auction, or towed into shallow water, as was the old "Texas," to serve as targets for rifle practice. We regret to note that not a few people have criticised the destruction of the "Texas" as a piece of wanton extravagance. As a matter of fact, this obsolete vessel is giving far more value to the navy as a target than she ever did during the palmiest days of her commission. The battleship or cruiser which has been "outbuilt" by the rapid march of improvement in naval material is more profitable as old junk than as lying in reserve at a navy yard. The money spent upon these ships in the endeavor to modernize them might just as well be poured into the sea. One dollar put into absolutely new construction is worth a million spent in tinkering up obsolete ships.

As with the ships, so with the navy yards. The last report of the Secretary of the Navy tells us that we have several old yards which have outlived their usefulness and constitute a charge upon the country for which it gets practically no return. The policy of the scrap heap should be applied here with an unsparing hand.

New Orleans yard, to which no large ship of our navy could be sent in war time, for fear of its being blocked in at the passes; Port Royal and Charleston, both absolutely useless for battleships because their channels are silted up with sand and mud; New London, barred from the sea by a railroad bridge—these and others should be scrapped and abandoned. The maintenance of these lesser and useless yards from motives of sentiment or politics is working decided harm to the interests of the navy at large by the diversion of money, time and attention from those fundamental objects at which the present enlightened policy is aimed.

The Status of Agricultural Meteorology

THE French Chamber of Deputies, at its session of December 22nd, 1910, passed a resolution calling upon the Ministry of Agriculture to undertake the development of work in agricultural meteorology—already carried on to a limited extent by the Department of Agricultural Hydraulics—and to take steps with a view to providing in the budget of 1912 for the organization of a special service devoted to this subject. By an order of April 10th, 1911, a committee of sixty-four members, having at its head M. Violle, of the Institut de France, was organized under the direction of the Ministry of Agriculture to prepare plans for the proposed service. At the same time the French government sought the advice of organizations in other countries engaged in this class of work, including the United States Department of Agriculture. Apparently the new service is to be independent of the existing meteorological department of the French government, viz., the Bureau Central Meteorologique, which is under the Ministry of Public Instruction.

It is noteworthy that France, following the example set a few years ago by Russia, is about to organize a separate and distinct meteorological service for the benefit of agriculture. In the United States, official meteorology is already under the direction of the Agricultural Department, to which the Weather Bureau is attached, and the act of Congress under which this bureau was organized provided that it should be "specially developed and extended in the interests of agriculture", but in foreign countries an analogous affiliation does not generally exist. Apparently the European meteorological services, which for the most part have but meager funds at their disposal, are not able to be of much direct benefit to the tillers of the soil; and as a distinct group of problems, theoretical and practical, is involved in agricultural meteorology, it has seemed best to organize special services, rather than extend the scope and enlarge the resources of the general services already existing.

This movement found expression at the last meeting of the International Institute of Agriculture, at Rome, when the French delegate, M. Louis Dop, presented an elaborate report on the work in agricultural meteorology now officially carried on in various countries, and offered a resolution, which was adopted, looking to the international organization of such work. This matter will be submitted to the International Meteorological Committee, which, it is expected, will appoint a "commission" on agricultural meteorology, co-ordinate with the commissions that have been appointed from time to time on aerology, atmospheric electricity, solar radiation, etc.

The subject of agricultural meteorology, owing to the fact that it has not heretofore been looked upon as a distinct branch of science, has received far less attention than its immense economic importance entitles it to. The interrelations of weather and climate, on the one hand, and the life and growth of plants on the other—including such matters as the geographical distribution of plants, photochemical climate, phenology, the causes and effects of frost, the meteorology of soils, æolian geology, acclimatization, drought resistance, and such practical problems as frost protection, hail insurance, and weather forecasting for particular crops—should be recognized as a field of research requiring the attention of a numerous corps of workers, trained in both meteorology and biology. At present the workers in this field are very few. Particular problems have been studied from the meteorological or from the biological point of view, but no general survey of the field has yet been taken, and there does not exist, to this day, a textbook of agricultural meteorology worthy of the name. There is no greater desideratum, in the literature of either meteorology or agriculture.

A New System of Gathering Turpentine

Conserving the Long-leaf Pine

THE old system of boring long-leaf pine trees for the purpose of collecting turpentine is the most wasteful and destructive method that has ever been used. It is not only the most expensive from the standpoint of labor, but it invariably weakens the trees and always subjects them to destruction from wind and fire. Less wasteful methods have been devised for extracting the resin, yet a good many turpentine men persist in cutting large receptacles or openings on either side of the trees near their bases in which the resin collects. (See Fig. 1.) These holes or boxes, as they are commonly called, are from 8 to 14 inches wide, running up 7 to 8 inches along the length of the tree, and from 4 to 6 inches deep. The trunks are repeatedly hacked immediately above these boxes, thus exposing new scarified surfaces from which the resin oozes and collects in the boxes below. This process of hacking is continued upward on the trunks as high as the men can conveniently reach, and is repeated for five to seven years until the trees are considered fully worked.

With this method there is an enormous amount of waste. Not only is there a 50 per cent waste through evaporation of the pure turpentine oil, which sells for $4.00 per gallon, but in gathering the crude resin from the boxes large quantities are lost through careless handling. A good deal of foreign material, such as scales of bark, chips and needles of the trees, becomes mixed with the crude resin which is collected from the boxes and scraped off the scarified surfaces.

About ten years ago another method was devised which is known as the cup and gutter system. This system has its advantages over the old one in that it does away with the injurious methods of cutting the boxes into the trees. Only the sap wood of the tree is penetrated by this method, and one cup with two gutters which drain the resin into the cup is attached to the foot of each scarified surface. (See Fig. 2.) These cups have a disadvantage in so far that hogs and other animals which feed in the pine forests frequently throw them off the hooks which hold them in place. Evaporation is not wholly eliminated by the use of this method. The earthenware cups also have another disadvantage, since a good many are constantly broken even under reasonably careful handling and must be replaced at a considerable expense. Nor does the use of this system greatly lessen the fire danger, for the resinous substance on the scarified surfaces often catches fire when the woods are burned over, which is done regularly every year in the southern pineries. These periodic conflagrations which consume annually not only millions of acres of young growth but also many millions of feet of merchantable timber, can thus be directly or indirectly attributed to the cause of improper methods of turpentining. The present rate of this destruction is so great that within the next fifteen or twenty years the resin yielding pine forests of the South will be wholly depleted.

It is very important, therefore, that a less destructive method of turpentining should be used. A new system of collecting turpentine in air tight jars which was put into practice a little less than a year ago promises to be the most economical method ever devised, and it is this system which may possibly revolutionize the turpentine industry in this country. To



Fig. 1.—The old "box" system.



Fig. 2.—Cup and gutter method.



Fig. 3.—System of turpentining with an air-tight cup attachment.

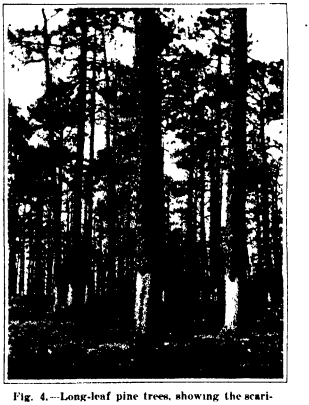


Fig. 4.—Long-leaf pine trees, showing the scarified surfaces.

A NEW SYSTEM OF GATHERING TURPENTINE

cut the timber without having it turpentined is equivalent to throwing away the whole of the profits that could be derived therefrom. But the turpentining should be done only provided the oil can be extracted, with absolutely no damage to the timber or to the lumber product. Frequently turpentine men lease their long-leaf timber for $2.50 per acre for the privilege of working it for the turpentine, though the timber on it may be worth $4.00 per acre to the saw mill men. After the turpentine operator is through with the job fully one-half of the trees are invariably dead, all are fire scarred, and those which remain after nine years (the usual length of a lease) are worth to the millmen only about $2.00 per acre.

The new turpentine cup system consists of an air-tight glass jar of about one pint capacity which screws into a metallic cover similar to a tin can top. (See Fig. 3.) To this is attached a somewhat similar cap at right angles which is placed into a shallow 2 inch hole bored into the sapwood of the tree. A metal brace of the same material as the cover serves to hold the caps at right angles to each other. The brace is hollow and provides a passage for the resin from the tree into the glass jar which is attached to the horizontal cap. The cup is firmly attached to the tree by first smoothing off the rough outer bark over a few square inches and then placing an ordinary extension bit of the vertical cap into the hole to a depth of about one-fourth inch. Before forcing the vertical cap into the hole two three-quarter inch diverging holes several inches deep with a slightly upward inclination are bored from the center of the larger hole. The vertical cap is then bored into the large hole and a glass jar screwed into the horizontal cap. The gum flows from the three-quarter inch holes into the vertical cap and from there through the hollow brace into the glass jar. When the jars become full they can be unscrewed emptied and replaced.

This method has proved very successful, and it will not only be a great thing for the turpentine industry but it will be a great step in advance toward conserving the long-leaf pine which is being rapidly depleted through improper systems of extracting the turpentine. The system has the advantage that it can be continued for an indefinite period without damage to the tree. It is the only method that protects the trees and saves all waste. The pines thus tapped will last for a number of years. The system not only does away with the old chopping or hacking method which is very expensive and destructive operation but it protects the tree from fire which is almost inevitable when dry scarified surfaces are exposed and moreover the trees are not retarded in their growth.

Wooden Shoes

ACCORDING to a report from Vice Consul D. P. De Young at Amsterdam, Holland exports more wooden shoes to the United States than to any other country. Many hundred pairs are now worn in Michigan, Iowa, Missouri, New Jersey, and other States. The remarkable statement is made that there is more wooden footgear worn in Chicago, Grand Rapids, or Holland, Mich., than in the city of Amsterdam. Other sections importing this practical article of dress extensively are Paterson, N. J., St. Louis, Mo., Lancaster County, Neb., and Marion County, Iowa.

The shoes exported from the Netherlands are mostly made in large factories by modern machinery. On the contrary, the wooden shoes worn in that country are generally hewn to the measure of the customers' feet in the village shoe shops, and the local price varies according to the amount of lumber used and the market price of the raw material.

Two New Blériot Monoplanes

Descriptions of the Latest Aeroplanes of the Celebrated French Pioneer

Not content with having won practically all the great European circuit aerodrome races during the past summer, M. Blériot has been hard at work of late evolving new designs. His two latest monoplanes, one a racer and the other an experimental "Canard" or "Duck," are illustrated herewith.

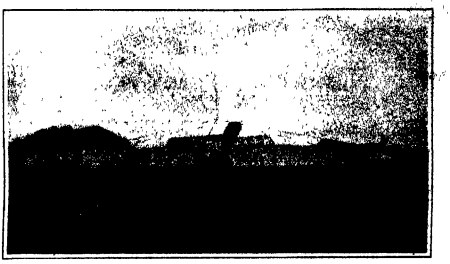
The new racer displays a general refinement of lines and an effort to reduce head resistance. To effect the latter, the upper flat cross member of the chassis has been lowered and placed under, instead of on top of the body. The resulting shortening of the steel-tube uprights of the chassis serves to reduce head resistance. But in addition to this the body has been made extremely narrow in front, while at the rear it flattens completely and terminates with an absolutely flat horizontal rudder. The extreme front end narrows down to not much over a foot in width but where the aviator sits it is of comfortable space. The motor and tanks are well covered with a long aluminium hood so that there is little chance for the aviator to get oil in his face from the exhaust of the motor or from leaking tanks. The usual running gear and shock absorbers are used in front while the bamboo skid is now placed at the extreme rear end of the body or fuselage. Besides a simple V-shaped support for the guys above the wings, this new racer has the same arrangement below, but the tubes which form the lower support are considerably longer than heretofore and they are well guyed to the body. They carry at their lower ends the warping mechanism, which seems to be somewhat different from that used heretofore. The vertical rudder is of peculiar shape, its location on top of the body being similar to that of the rudder on the No. XII.

This new model No. 27, has a length of 7 meters (23 feet), a spread of 8.9 meters (29 feet) and a supporting surface of but 12 square meters (129 square feet). The weight complete is 430 kilograms (948 pounds), so that the weight lifted per square foot amounts to some seven pounds. With a 50 horse-power Gnome motor, this model Blériot has developed a speed of 130 kilometers (81 miles) an hour.

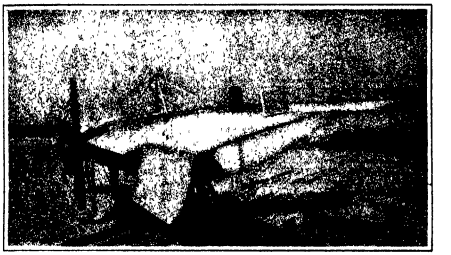
One of M. Blériot's early monoplanes was constructed upon the same lines as his latest "Canard," as this type of aeroplane with pilot in front in a covered body and motor behind has come to be called. The Voisin brothers were the first to bring out a biplane of this type some months ago, although Santos-Dumont was the inventor of it and the first aviator in Europe which he became with this type of machine. The Voisin "Canard" has a much longer body. It has been fitted with hydroplane floats and has made many excellent flights from the water. It is seen skimming the surface in one of our illustrations.

The new Blériot "Canard" is much shorter than the Voisin. It is a monoplane with a thick short body projecting out in front, the horizontal rudder being at the bow. Two vertical rudders on top of the main plane at each end serve to steer. The wings are guyed to an inclined rod underneath which extends forward from a shoe on the bottom of a vertical post. There is no warping, generous ailerons being used instead. The leaf spring, axle and the stout to which the wings are guyed, recall the Nieuport monoplane. They are quite similar.

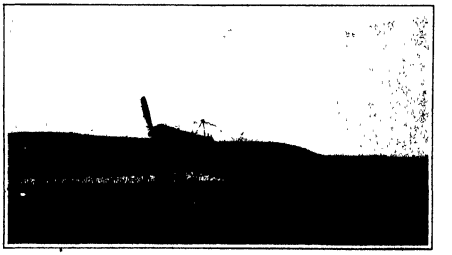
The total over-all length of this new monoplane is but 6.5 meters (18 feet). The spread and surface are the same as with the racer, while the weight with a 50 horse-power Gnome motor is 400 kilograms (882 pounds). The aviator's seat is so far forward that it would seem as though he ran very little chance of being injured by the motor in case of a smash, since there are five or six feet of stout fuselage between the engine and the pilot. No flights of any moment have been made so far as we know by this new machine as yet. There is no doubt that it will fly, however, nor that a machine of this type offers several advantages, such as have already been mentioned by Voisin in the description of his "Canard" in the SCIENTIFIC AMERICAN of recent date.



Rear view of the Blériot Canard.



The Blériot Canard, with motor and propeller at the back of the aviator.



The new Blériot No. 27 as seen from the rear.



Front view showing details of Blériot monoplane.

TWO NEW BLÉRIOT MONOPLANES

The Aeroplane in Naval Service

By André Beaumont

In a recent issue of the Paris "Le Temps," the young French naval officer who has made such a brilliant record as an aviator under the pseudonym of André Beaumont, discusses the present status and future possibilities of the aeroplane as a factor in naval maneuvers. We take pleasure in reproducing here the greater part of this interesting exposition, omitting some introductory remarks of a biographical character, and taking up the author's words at the point where he enters upon his main theme.—ED.

Must we seek for marine service the ideal machine which takes flight from the earth, poises itself upon a troubled sea, renews its flight unharmed, executes maneuvers about the fleet, and then at will returns to land or casts anchor in port?

Unfortunately such a machine does not exist to-day, and I am afraid it will not be produced for a year or two, despite the laudable efforts of our constructors, and meanwhile must we be deprived of the aid of aviation in the marine?

To my mind that would be a mistake, and we should be depriving ourselves of an auxiliary already powerful and capable of becoming redoubtable if handled with the skill and daring which have always been among the professional qualities of sailors.

Why wait for future progress when the actual state of affairs is so satisfactory?

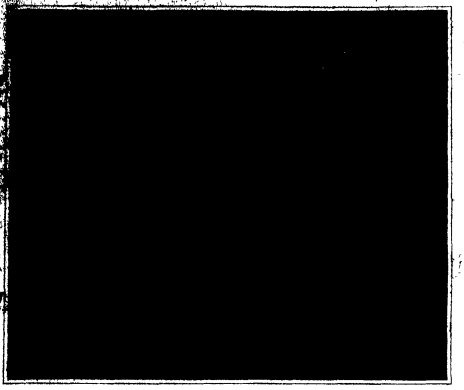
Let the constructors continue their researches; let us help and encourage them, and, if necessary, undertake parallel studies in the navy. Let us urge experimental trials, but let us begin by adopting the actual machine that we may profit immediately by the progress attained.

Let us consider how the machine of to-day can be of service. We can have in the first place the "coast aeroplane," which, rising from a point of departure in proximity to a port of war, could fly out to a great distance over the water (30 miles, for instance), and, mounting to a great height, from 1,500 to 4,500 feet, according to the clearness of the atmosphere, descry upon the distant horizon the presence of a hostile squadron or a fleet of torpedo boats. It could observe the number, strength, formation, and direction of the enemy, and in less than an hour and a half return with a report which would at present require the employment of two or three cruisers, or ten torpedo-boat destroyers, and two or three times as great a lapse of time.

Then there is the search for submarines or mines placed by the enemy in the channels of safe exit from ports. The recent experiments of the aviator Aubrun at Cherbourg have shown that from a height it is possible to see a considerable depth down into the water.

The "aeroplane of the high seas" would be capable of a mission of larger extent and greater radius than the coast aeroplane. This is the machine belonging to a specially equipped convoy boat (*not* a man-of-war). The aeroplane rises from

(Continued on page 397.)



Ideal artificial lighting for a gallery, intensity of illumination practically uniform, light is directed to the walls, not the floor.



Excellent natural lighting obtained by the use of a prism-shaped monitor skylight with opaque top and diffusing glass sides.

Indoor Lighting, Natural and Artificial

Directed-indirect Illumination for Art Galleries

By Putnam A. Bates

EXTERIOR lighting involves problems of a quantitative character, whereas interior illumination is more qualitative, and while both are important, the successful solution of the interior problems has perhaps the greater practical value; for it is obvious that while indoors our eyes are subjected to greater stress.

Apparently there is no reliable and clearly defined record which will guide us in providing both natural and artificial conditions of illumination closely corresponding to those under which the eye is most capable of rendering its best service. At least an exhaustive search, in connection with which the writer has assisted, failed to produce any real data or indication of previous thorough and logical analysis, and consequently, in undertaking the illumination problem of an important exhibition picture gallery recently erected, it became necessary to inspect many of the existing buildings of similar nature, after which it was deemed advisable to approach the problem on entirely new lines.

While this article, therefore, will be confined largely to a description of the solution of the particular problem undertaken, there is much information brought out in the analysis that applies directly to the illumination of almost any kind of an interior, the principles, of course, being observed, rather than the exact arrangement or construction.

Quite to the writer's astonishment, no one seemed to possess the key to the whole situation, although many persons who were interviewed seemed to appreciate, in a rough way, the defects noted in the existing buildings. Daylight illumination has received a good deal of study in reference to special interior problems, but the records do not show that these investigations have been carried sufficiently far for us to learn from them the intensity of illumination that pictures, for example, should receive, or the best relative intensities for the various fired surfaces, ceiling, walls and floor, of a given room. Incomplete as were the daylight experiment data, the results from previous attempts to provide scientifically correct artificial lighting proved to be even more unsatisfactory. Before enumerating several of the violations most frequently committed, I will mention briefly a few of the principles governing the subject of light and its effect upon the human eye.

Through many ages, the human eye has accumulated the characters wrought upon it by evolution and the limitations of its environment. It works best over a rather limited retinal area and through a range in intensity of light which, although great, is yet much smaller than, for example, the extreme variations in brilliancy provided by the sun's rays. Everyone is familiar with the distress caused the eye by sudden alternations of light and darkness, and it seems to be well established that the discomfort caused by the reflected glare from sand, water or snow is due to the inability of the rather transparent lower eyelid to obstruct sufficiently the light that approaches the eye in an upward direction, a condition to which the human eye is not naturally accustomed. All these matters are of importance to consider in connection with interior lighting, and the subject of the following serves as an excellent illustration.

Visitors view pictures to study their relative merits, and are often so absorbed in this, as not to realize, until afterward, under what trying conditions their eyes have been used. The lighting of a picture gallery or exhibition room differs from other interior illuminating problems, but the underlying principles may, nevertheless, be otherwise applied when they are once appreciated. First, the main objective is to provide an illumination which will enable persons to view exhibits with the least possible discomfort or effort to the eye; second, the exhibits will be on the walls and, therefore, the light must be directed there; it, however, must be diffused; third, should the floor be especially bright, or the source of illumination in the field of vision, there is a physiological effect exerted upon the eye which makes the careful viewing of objects not only difficult, but most tiring.

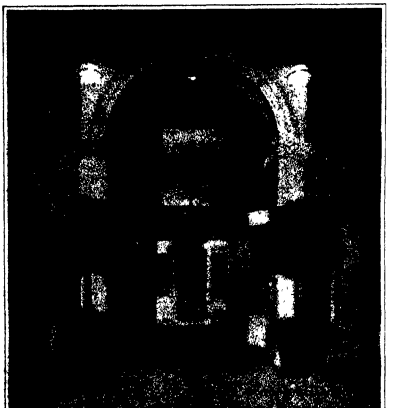


Fig. 2.—Lighting that does more harm than good.

The most suitable intensity of light and the seemingly contradictory requirements that it must be both directed and diffused are difficult conditions to establish, but it is obvious that in every picture gallery or exhibition room the need for solving these essential points has been felt. How frequently do we see the gallery skylight provided with a roller shade or an opaque canopy placed in the center of the room, under which observers may stand to view the pictures without exposure to the direct effects of the entering light. These are but makeshift methods of regulating the intensity, and by negative means, directing the light. Until most recently, however, these devices were regarded as essential features of gallery equipment.

An interesting feature of this situation was, that the results desired, as indicated by these makeshifts, were quite correct, for as one eminent critic described the situation, "the best results would be obtained if in some way the direct rays of the sun's light could be shut out, but the remainder of the daylight be admitted through an overhead skylight, and each visitor be provided with an open umbrella to hold over his head while viewing the pictures." This was the remark of an artist whose knowledge of science and physics was limited to his original observations, but his expressed idea conveyed to the writer that the full range of the sun's brilliancy was vastly too great, and its effect should be modified to correspond more nearly with the limitations of the human eye, and the largest portion of the entering light should be directed toward the walls and not allowed to fall directly on the floor, as is generally the case, where the hung canopy is not used. The canopy, however, is not a desirable intrusion at best, but it is often used to obstruct the downward flood of light which is sure to enter when the sun is high and the surface of the glass area is entirely skyward, a mistake in roof design heretofore almost universally made. It is nevertheless a fact that in spite of its unsanitary objections and unsightly appearance from a lighting standpoint, the presence of the hung canopy is to be preferred in galleries or exhibition halls where the skylight is so constructed. Hence the manner in which the light is admitted is all important.

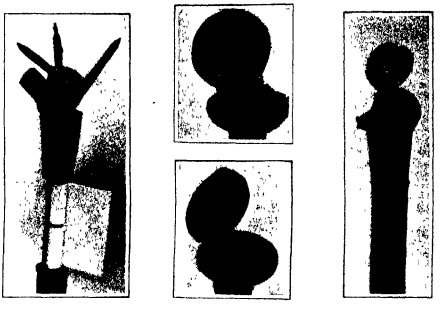
The area of the glass opening in the gallery ceiling governs the amount of light that can be admitted, but the shape of the superstructure or upper skylight practically determines the manner in which the light shall enter. Although well above the room in which the exhibits shall be, this "superstructure" should be most carefully designed. Its top must be opaque so

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Curiosities of Science and Invention

What French Walking-sticks Contain

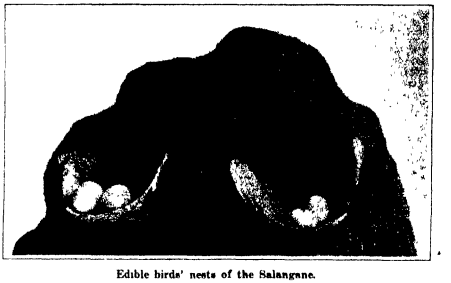
Some time ago we illustrated a number of French walking-sticks which were armed with weapons of various kinds ranging from daggers to rifles. The ingenuity of the Frenchman has not been confined to the making of weapons out of apparently harmless canes. In fact there is quite a variety of uses which the cane is made to serve. In the accompanying series of photographs, some of these are shown. In the figure to the right is a cane fitted with a coin box and a match box, these being contained in the head which is provided with a carefully concealed lid. The coin box is arranged to permit of depositing and easily removing the coin by a slight pressure of the thumb, thus obviating the necessity of fishing for coins in the pocket. The upper one of the two central figures shows a cane handle containing a complete outfit of the game known as Petits Chevaux. When the lid is open, betting can begin, and the horse crossing the wire first wins the stakes. One of the latest Parisian novelties consists in a ladies' parasol handle containing a roulette wheel which can be used for gambling at any place or moment. These handles have become very popular. They are of fine workmanship and generally of gold or silver. The last of the series shows a handle containing almost everything that one would be likely to need. A long sheet of paper is wound around the rod from which pieces may be torn off for taking notes. When the lid is opened penknife, pencil, nail file, combs and looking glass are disclosed. These objects are small, but large enough for practical use.



French walking-sticks and parasols serve many uses.

Edible Birds' Nests

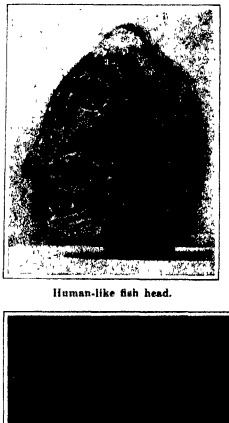
THE uninitiated are apt to think of birds' nest soup as a most disgusting stew of twigs, feathers and what not. As a matter of fact, the nest used by the Chinese is a very delicate semi-transparent gelatinous substance, built by the swallow-like birds known as the Salangane. The nests are found in the islands about Siam and the Malay Archipelago, and the harvest in the year 1909 was 18,000 pounds, valued at over $100,000. It used to be thought that the nest was formed of inspissated saliva secreted by the highly developed glands of the bird. Now it is known that the nest is made of a species of alga gathered by the bird. The season for harvesting the nests lasts from April until September. It takes three months to build the first nest, and just before the eggs are laid the nest is stolen by the collector. The bird immediately sets about the building of a second nest, taking thirty days for the work. This is also stolen before the eggs are laid. The third nest, however, is unmolested and the birds are permitted to raise their young after which the nest is taken and sold. The nests are built in most inaccessible spots upon the cliffs along the coast and the natives must risk their lives to reach them. In preparing birds' nest soup the nest is washed in cold water and then cooked for eight hours in a closed vessel, after which it is mixed with chicken broth, seasoned and boiled for a quarter of an hour. This dish is considered a great delicacy among the Chinese, and Occidentals who have tried the soup find it very palatable and much resembling chicken soup.



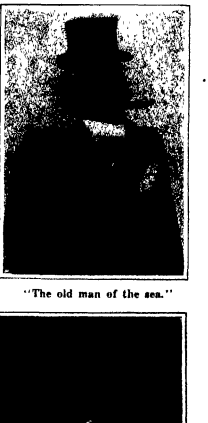
Edible birds' nests of the Salangane.

The Old Man of the Sea

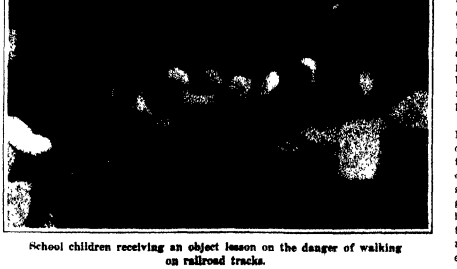
PROBABLY one of the most curious of all the marine creatures that have been brought to light in recent times is the fish head here shown, possessing a startlingly human-like appearance. "The old man of the sea," as the fish has been dubbed, was picked up in the waters around Cape Town, Africa. The realistic photographs shown were made at the New York Aquarium. The head was not manipulated in any way. The ragged outline at the back of the head shows where it was severed from the body. The lines on the lower part of the face are natural and are the outlines of the maxillary and other bones of the jaws. The nose has shrunk somewhat in drying. In life the resemblance to the human face was even more striking. The conical front teeth are shown in the photograph. The lateral teeth are very strong and molar-like, evidently for the purpose of crushing shells and, like the famous king of the Cannibal Islands, "he has two rows in his lower jaw." Photographs of the head have been sent to a number of well known authorities on Ichthyology in America, Europe, and Africa for the identification of the species.



Human-like fish head.



"The old man of the sea."



School children receiving an object lesson on the danger of walking on railroad tracks.

Fatalities to Trespassers on American Railroads

THE number of lives lost in wars today, with fighting continually going on in some corner of the world, is nothing as compared with the annual record of fatalities due to trespassing on American railroads. Ignorance or carelessness on the part of the trespasser is responsible for most of this. The railroads are bending every effort to cut down the awful toll of death by posting signs and maintaining police patrol, but they will never be completely successful without the cooperation of the general public.

Every densely populated industrial center near a railroad is a death center. The working classes in crowded districts, and tramps, furnish the majority of victims. Railroads say people must be taught to have more respect for their lives and safety.

With education of this kind in view, the Pennsylvania Railroad is preparing *pamphlets* in eight or nine languages. These will be distributed in schools with instructions to the pupils to take them into their homes. The Board of Education of the State of Pennsylvania has promised its aid. The assistance of clergymen has been solicited, and from hundreds of pulpits the danger of trespassing has been preached. From the good roads trains run through rural districts, and in the farmers' granges the warning has been sounded.

As a result of the education movement and a vigorous campaign against tramps, the number of persons killed while trespassing on the Pennsylvania Railroad's property in violation of the law, has been gradually reduced from 887 in 1905 to 585 in 1910, and the number of injured has fallen from 794 to 682 in the same time. To put these figures in another way; in 1905 the railroad was killing trespassers at the rate of three a day for five months of the year, and two a day for the remaining seven months, while in 1910 the number sacrificed had decreased to two a day for seven months, and one a day for the other five. Railroads are perhaps the greatest sufferers from the tramp evil, and they are willing to do all in their power to stamp it out, but this cannot be accomplished until the citizen realizes the seriousness of the matter and takes his part in the campaign.

Until this country follows the lead of Europe in the matter of legislation to check vagrancy there can be no satisfactory cure for the evil, but if the small communities will punish offenders, instead of passing them along, it will be greatly ameliorated. By doing this, and by aiding the railroads in their campaign to educate the public against trespassing, more loss of life will be averted than by establishing world peace.

Engineering

Record Cargo on the Pacific.—The carrying power of the large freight steamer is well illustrated in the cargo of the steamship "Minnesota," which will sail from Seattle next December with a cargo which establishes a record in the Pacific trade. She will carry 16,000 tons of flour and 2,000 tons of general merchandise, every cubic foot of her tonnage space being occupied.

Towing Locomotives for the Panama Canal.—The Isthmian Canal Commission will shortly advertise for bids for an experimental towing locomotive for towing steamers through the locks of the Panama Canal. Should this machine be successful, bids will be asked for thirty nine more. Four locomotives will be used for each vessel, one on each bow and one on each quarter. The locomotives will run on rack railways, and they will be sufficiently powerful to hold the largest vessel in absolute control.

The Ram a Terribly Destructive Weapon.—Although it is considered that the ram will rarely be used as a weapon of attack in future naval conflicts, there can be no denying its destructive power. A recent survey of the "Olympic" in the dry dock of Harland & Wolf shows that there is a triangular hole in the ship's side reaching from a point 14 feet above to 30 feet below the water line, which will take from six weeks to two months to repair, and will cost about half a million dollars.

Slides at Gatun Locks.—The excavations for the Gatun Locks have caused slides of some magnitude to occur, and the removal of the material will cause a delay of some four months' time. As usual, the occurrence of a slide has provoked alarming rumors, and, as usual, the trouble has been greatly exaggerated. As in the Culebra Cut, so here, the material is of an unstable nature, but when the difficulty has been met as it will be, the construction of the locks will proceed, and once the concrete work is in, all trouble from earth movements will have ceased.

The Reconstructed Battleship "Oregon."—None of the older battleships of our navy is better known or has a more sentimental interest for the American people than the battleship "Oregon," whose voyage around the world terminating in her active participation in the battle of Santiago, will long be remembered. This ship has been undergoing a thorough reconstruction and she is now being given exhaustive tests to ascertain her effectiveness for modern war duty. Particular attention will be given to her new fire control system, to the wireless apparatus, and to other modern equipment.

Navy Yard Reforms. As the result of Secretary Meyer's recent visit of inspection among the European navy yards, he has decided to make a tentative adoption at the Norfolk yard of the system of yard management which is in force at the yards of Vickers Ltd., Barrow-in-Furness, England. This system has been worked out by the Vickers firm along the general lines of scientific management of which we have heard so much lately in this country. In the opinion of the Secretary, it is better adapted to conditions in our yards than the admirable but elaborate method known as the Taylor system, which has tended to provoke rather serious opposition on the part of the labor unions.

Russian Naval Activity.—The dreadnought "Gangut," the fourth of the powerful dreadnoughts which Russia is building in the Baltic, was recently launched. This vessel is one of a class of four ships, including the "Gangut," the "Petropavlovsk," the "Sevastopol," and the "Poltava." These vessels are of 22,300 tons displacement, and their distinctive feature is the method of carrying the main battery of twelve 50-caliber, 12 inch rifles. These will be mounted in four three-gun turrets, one forward and one aft on the center line and one on each beam, the two beam turrets being placed diagonally. This will give a theoretical concentration of fire greater than that of any other ship, namely, nine 12-inch ahead, nine astern, and twelve on each broadside.

Fender Chains at the Gatun Locks.—The character of the bids which are being asked for work on the Panama Canal indicates how nearly this great work is approaching its final stage. Proposals have been asked for materials for the heavy chain fenders for preventing ships from running into the lock gates with which all the locks will be provided. Ships will not be allowed to navigate the locks under their own steam; but should they escape from the control of the towing locomotives, they will be prevented from running into the gates by massive chains stretched across the lock, and controlled by powerful hydraulic cylinders, which will exert a resistance represented by 750 pounds to the square inch on the pistons. A 10,000-ton ship running at four knots an hour, striking the fender chain, would be stopped in a distance of 72 feet 6 inches.

Science

Lamps for Lighthouses.—The use of electric lamps for lighthouses presents certain disadvantages. It is therefore with some interest that we follow the course of some experiments in France on the use of a new kind of incandescent light for lighthouse purposes. The lamp in question has a number of filaments mounted somewhat after the fashion of the filaments of an incandescent gas mantle. In this way a very strong light is secured, which, moreover, has the desirable property of being very uniform in all parts of the circumference. According to recent trials the new type of lamp gave twenty times as much light as a Welsbach burner and required very little attention. The lamp is particularly adapted for shore lighthouses which are easily placed in communication with electric light mains.

Improvement in Incandescent Gas Lighting.—Experiments are at present in progress in Paris as the result of which it is hoped to secure an increased light efficiency from incandescent gas burners. Under present conditions, the gas pressure in the mains is sufficient to draw a certain amount of air into the burner, where it becomes mixed with the gas, causing the characteristic blue flame. But the amount of air thus drawn into the flame is only about three times that of the gas, whereas, for the best effect, the ratio should be five to one. It has been found that by compressing the gas in the mains the desirable ratio of air can be caused to enter the flame. One of the boulevards in Paris has lamps working on this system, and the results are exceedingly satisfactory.

Electric Light for Sterilizing Milk.—We read in a Daily Consular Report a note from Consul Mahin, of Amsterdam, according to which a local periodical refers to the effect of ultraviolet beams on bacteria and to the fact that such beams are abundantly developed by mercury incandescent lamps and relates that through this medium milk may now be sterilized in a few minutes. An apparatus has been constructed, it is explained, whereby the milk flows in a thin stream along an electric light. Demonstrations were first made with water infected with different kinds of bacteria and it is said that the water was purified in a few minutes without appreciably increasing its temperature. The result is attributed to the ozone formed under the influence of the light, but the demonstrations must be conducted where there is sufficient room for the light to burn freely. This method of sterilization without heating or adding preservatives, is believed to have great hygienic value in respect to nursing children.

The Influence of Dust on Mortality.—Out of every thousand of those whose occupation calls for constant work in dusty quarters, five die of consumption according to German official figures, whereas among those who are not exposed to the action of dust, only two out of a thousand die of the disease named. As regards the comparative danger of the different sorts of dust, the following figures will prove instructive:

KIND OF DUST	
Metallic	
Iron	6
Lead	8
Mineral	
Stone	35
Porcelain	14
Organic	
Leather fur and feathers	5
Wool and cotton	5
Wool and paper	6
Tobacco	7
Total	86

Influence of Room, Light and Fresh Air on the Growth of Children.—To show the influence of room, light and fresh air on health and growth, the following figures are given, concerning the height and weight of boys in Bourne Village, England, as compared with those in Birmingham slums. Bourne Village has 840 houses, distributed at the rate of only nine to the acre; at the time of making up this table, the population was 4,000.

Weight of Boys (pounds)

Age, years	6	8	10	12
Bourne Village	45	52 9	61 6	71 8
Birmingham slums	39	47 8	56 1	63 2

Height of Boys (inches)

Age, years	6	8	10	12
Bourne Village	44 1	48 3	51 9	54 8
Birmingham slums	41 9	46 2	49 6	52 3

The death rate (average of five years) is for Bourne Village 8.5 and for England and Wales 14.9, per 1,000. The infant mortality (average of five years) is for Bourne Village 68 and for England and Wales 121.8, per 1,000 live-born children.

Electricity

Royal Experiments in Wireless Telegraphy.—King Albert of Belgium is keenly interested in wireless telegraphy. He has a complete radio-telegraph equipment in his palace at Laeken where he is fond of conducting experiments.

Hydro-electric Power for Constantinople.—Constantinople is soon to be supplied with electricity from a hydraulic power station on the Sakaria River, 80 miles away. Here two turbine stations will be built, one of 15,000 horse-power using a 180 foot head of water and the other of 8,000 horse-power, employing a head of 120 feet.

Electric Railroads in the Pyrenees.—About 500 miles of railroads are being built in the Pyrenees. These railroads are to be operated by electricity which will be furnished from water power stations in the mountains. Power will be supplied at a voltage of 6,000 volts, which will be stepped down to 12,000 volts for the trolley wires. The locomotives will be provided with transformers for further reduction to 285 volts.

Novel German Transmission Poles.—A novel type of reinforced concrete pole is now being used in Germany for transmission lines. The pole as perforated from the top to a point near the base. The perforations are large enough to permit of inserting the foot so that the lineman does not require climbers to reach the wire brackets at the top. The poles are thus virtually given the form of narrow ladders.

Wireless-Controlled Submarine.—According to a recent press report some interesting experiments have been conducted by the British navy in the control of submarine boats from cruisers. These experiments have been kept very secret but it is known that a submarine boat in the waters off Solent was controlled by wireless telegraph apparatus aboard the cruiser "Furious." Experiments were also conducted with torpedoes controlled by Hertzian waves.

Electric Power from Water Supply.—The Wachusett reservoir, which supplies Boston with water has a capacity of 68,000,000 gallons. The reservoir is located 395 feet above the level of Boston and as a 300 foot head is considered ample for the city the balance is to be used for the generation of power. A hydro-electric plant comprising four turbines of 1,000 kilowatt capacity, has been installed. The plant has cost $125,000 but the current it will supply should bring in a revenue of $25,000 per annum.

Overhead Alternating Current on Swiss Railways.—After seven years of study, a commission appointed by the Swiss Republic to investigate various methods of electrification has decided to recommend the overhead rather than the third rail system for the Swiss National Railways. There will be 1,830 miles of railroad in the Swiss system and it recommends that a single-phase alternating current be used at a pressure of 15,000 volts. The cost of the entire system will be about thirteen million dollars.

Electric Trucking.—In his presidential address before the Electrical Vehicle Association of America Mr. W. H. Hood Jr., referred to the fact that the average amount of freight handled on the streets of Boston per day amounts to 25,000 tons and that the total freight carried by wagons in the United States is more than ten times as much as that carried by railroads. He pointed to these facts as indicating a large field for motor trucks in this country and stated that were this freight handled by electric power it would require three million power wagons.

Battery Truck Crane.—There has been a demand at great railway and marine terminals and in manufacturing plants for a device for handling freight and materials over moderate distances. To meet this demand an electric motor truck fitted with a swinging crane has been designed by the General Electric Company. The crane's hook is raised and lowered by a one ton hoist driven by a motor which together with the motor that operates the vehicle is supplied with current from a battery. The motor truck crane is mounted on traction wheels and has a short wheel base so that it may make sharp turns about shop aisles and among piles of material in congested piers and storage yards.

Storage and Primary Batteries.—According to a preliminary report issued by the Census Bureau the value of the storage and primary batteries manufactured increased from $3,679,000 in 1899 to $14,244,000 in 1904 and $10,612,000 in 1909, or 188 per cent during the decade. Both storage and primary batteries consist of various elements which are not always combined and sold together as a unit by the same manufacturers, and yet it is not until these are brought together that a complete cell is constituted. Many of the parts and supplies used are manufactured outside of the electrical field and therefore the statistics shown in this report do not convey a correct idea of the importance of this branch of the industry.

Dropping Bombs from Flying Machines

The Aeroplane as an Offensive Weapon of Warfare

By Riley E. Scott, formerly Lieutenant U. S. Army

IN this age of scientific armament, every new invention that bears at all upon the art of warfare is carefully weighed in the balance of military usefulness. The balloon, telegraph, telephone, automobile, motorcycle and more recently, wireless telegraphy, have all demonstrated their ability to further the dread game of war and have, consequently, been added to the standard equipment of armies. While enthusiasts are heralding the advent of universal peace, the silent, non-sentimental sentinels of warfare are eagerly acquiring every device and invention that may give them an advantage in the next clash of arms—perhaps the world's greatest war!

To the military man, warfare is a science, no sentimental theories or fancies enter into his cold calculations, no "dream of the ages" appeals to him unless it can add to the efficiency and destructiveness of his engines of war. Consequently, when word went round the world that man had flown, that a heavier-than-air machine had actually risen from the ground, military authorities did not let enthusiasm run away with judgment; they placed a "watch" on this new invention and the more progressive nations took steps to test it carefully with a view to its use in warfare. Within less than three years, its usefulness, even necessity, for scouting and reconnaissance work has been proven beyond a doubt and in consequence, the aviator has taken his place in the military establishment and aviation corps have become a part of the organization of armies. From developments in recent maneuvers, it is safe to predict that, in the next great war, the initial battle-clash will be between squadrons of scouting aeroplanes and that many a deed of devotion and daring will inspire the pen of the future historian.

Much has been said and written lately about the use of the flying machine as a destructive weapon. "Bomb" dropping has been a popular feature of recent aviation meets and enthusiastic reporters have given their imaginations full rein, with the result that cities have been destroyed, forts demolished and battleships sunk. It must be observed, however, that all such tests have been made from heights of three hundred feet or less, at which range an aeroplane would not have a ghost of a show against machine guns, shrapnel, rapid fire guns or even rifle fire. When we consider aeroplanes flying at reasonably safe heights say between one and two miles the problem of accurately dropping projectiles becomes a difficult one and scientific calculation must take the place of guess-work.

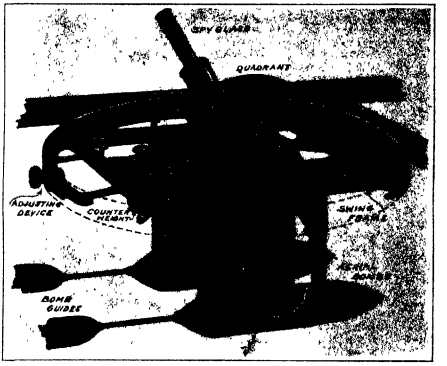
Granting that a reasonably accurate method has been or will be developed for dropping projectiles, let us inquire what damage can be done.

1st. Against Armies.—At the beginning of a battle usually about one-third of the troops are on the firing line in extended order, while the remaining two-thirds are massed in supports and reserves in the rear of the firing line in positions offering the best protection from the enemy's fire. These supports and reserves are massed in close order, they cannot be greatly extended for the commanding general must have them under his thumb in order to quickly reinforce weak or threatened parts of his firing line at any time. Still farther to the rear are the wagon trains, artillery parks, lines of communication, supply depots, etc. An aeroplane operating against armies in the field would, therefore, probably use *shrapnel*, an explosive shell filled with hundreds of bullets and equipped with a time-fuse in such manner that it can be exploded above bodies of troops on the march, supports, reserves, wagon trains, camps, etc. Shrapnel is considered one of the most effective projectiles used in modern warfare, and it does not require a military expert to imagine the havoc it would work on a body of troops *en masse*. Moreover the moral effect of such a weapon would be tremendous.

2nd. Against Cities.—In operations against cities, aeroplanes would use incendiary bombs, small bombs filled with some material which would set fire to combustibles on contact. Dozens of such bombs could be carried and a few aeroplanes could soon start a general conflagration. Any activity on the part of the fire department could be quickly dampened with a few shrapnel.

3rd. Against Fortifications.—Any one familiar with sea coast fortifications knows that the accuracy of the big guns mounted there depends altogether upon the range-finding system. These systems are of two kinds, horizontal and vertical. Both systems depend upon more or less delicately mounted instruments, mounted in buildings screened and protected from the harbor but not from the *sky*. In fact, they must be above the parapet so as to get an unobstructed view toward the harbor. Consequently, it would not be necessary to pick out the separate emplacements and guns for destruction, it would only be necessary to drop a steel projectile filled with high explosive, lyddite, for instance, on or near the range-finding bases. These being out of commission, the costly guns become as useless as so much junk. Magazines, barracks and store-houses could also be destroyed.

4th. Against Battleships.—The most difficult target for an aeroplane would probably be a battleship, on account of its relatively small size and its rapid movement. Night attacks and attacks while at anchor would probably be the most usual, although, in a naval



An instrument for directing bombs from aeroplanes.

battle, aeroplanes would be able to do much to harass the enemy. A few well placed shrapnel exploded above the gunners would not tend to increase their accuracy, and, better, smoke bombs exploded to the windward would do much to destroy accuracy of aim. Then a high explosive would be used, and, unless protective decks are materially strengthened, would be terribly effective. Authorities to the contrary notwithstanding, the writer holds that a steel projectile filled with 200 pounds of high explosive, striking with a velocity of 500 feet per second, even though it should not penetrate the protective deck, would work terrible havoc to a battleship. Present development points to the early construction of aeroplanes that will be able to carry a load of 1,000 pounds to a height of a mile and remain there for several hours.

On the other hand, those who have studied the question carefully believe that an aeroplane flying at heights greater than one mile will be a very difficult target, indeed, for gunners on the ground. Some of the reasons for reaching this conclusion are as follows:

1st. The aeroplane is not confined to movements in a horizontal plane, but may move in any plane. Those familiar with the subject know that, in order to hit a moving battleship from a seacoast gun, it is necessary to plot ahead and lay the gun ahead of the ship, just as a shot gun is held ahead of a duck. With a swiftly moving and, probably, zig-zagging aeroplane, it will be much more difficult to plot speed and direction and lay ahead than in the case of a battleship.

2nd. The difficulty of accurate aiming in high angle fire is generally recognized.

3rd. Refraction, or the bending of light rays from a rarer to a denser medium, will complicate matters.

4th. Projectiles fired at a very high angle, especially at aeroplanes hovering over an army in the field, will return to the vicinity from which fired, whether the target is hit or not.

5th. An aeroplane in close quarters would probably drop smoke bombs to obscure the enemy's vision, on the principle of the cuttlefish.

However opinions may differ, the rapid development of the aeroplane for military and naval purposes, especially in Europe, behooves us to consider it most seriously in the problems of seacoast and canal fortification that now confront us. We like to boast of our splendid isolation, of the steel throated monsters that guard the entrances to our harbors. Suppose, for instance, that, ten years hence, every battleship is equipped with flying machines; also, that an enemy's fleet appears fifty miles off New York. Would it be necessary to pass our forts in order to destroy the metropolis? Hardly; a fleet of aeroplanes would be despatched; within an hour they would be over the city; obeying wireless orders from their commander, they would maneuver over the thickly built section and soon it would be a mass of flames. Fantastic? Possibly so; but, in view of the recent extensive and successful use of the aeroplane in European maneuvers and, also, of the fact that other nations are spending many millions of dollars for aeronautical purposes, it might not be unwise for our Congress to depart from its usual policy of economy by appropriating a million dollars to enable the army and navy to fully test this new arm. Nations, as well as individuals, are sometimes penny wise and pound foolish.

A careful study of the problem of dropping projectiles reveals a certain relationship to the problems presented in mortar fire. In mortar fire, the theoretical trajectory of the projectile is a parabola, as shown in Fig. 1. Neglecting atmospheric resistance, the ascending and descending halves of the parabola are equal and symmetrical. The apex of the trajectory is a point at which the vertical component of the muzzle velocity has been used up in overcoming gravity and only the horizontal component remains. From this point the projectile falls with an acceleration due to gravity and, theoretically, would strike a target on a level with the muzzle of the gun with the same velocity it had when it left the gun. It is evident that, if an aeroplane should be moving on a level with the apex of the trajectory considered and in the vertical plane containing the trajectory, with a velocity equal to the horizontal component of the muzzle velocity, and should, at the apex, drop a projectile of the same weight, size and shape as that of the mortar, the projectile thus dropped would take the identically same path and strike with the same velocity as the mortar projectile. In other words, the problem is similar to that of mortar fire and only one-half of the trajectory has to be taken into account.

Briefly considered, the mathematical aspects of the problem are as follows: If an aeroplane, moving horizontally *in vacuo*, with a velocity of, say, 20 meters per second, should release a projectile at a point, *A*, Fig. 2, the projectile would take a parabolical path whose form and equation would be determined entirely by the height of the aeroplane and its speed with respect to the surface of the earth. The general equation of such a parabola is readily calculated and is, $x^2 = \frac{2v^2}{g} y$; in which x is the horizontal distance in front of the target at which the projectile must be released; y is the height above the ground; v is the velocity of the aeroplane with respect to the ground; g is the constant of gravitation for the particular place. Knowing all the factors in the second member of this equation, the value of x is readily found. This gives a right angle triangle, *AOT*, Fig. 2, in which, knowing x and y, the angle, α, at which a line of sight (telescope) in the vertical plane containing the target must be set in order to strike the target, *T*, can be readily computed. Each velocity of the aeroplane and each height will, when substituted in the above equation, give a different triangle and, con-

sequently, a different value for the angle, *a*. Substituting for every possible height and every possible speed will give a series of values for this angle which may be easily tabulated.

This discussion has considered the projectile in vacuo. It is apparent that the resistance of the atmosphere will depress the trajectory, as shown by the dotted lines in Fig. 2. Consequently the table above referred to would have to be corrected for atmospheric resistance and additional correction-tables constructed for winds and hygrometric conditions. Such correction tables would be relatively simpler than similar tables used in artillery and naval practice.

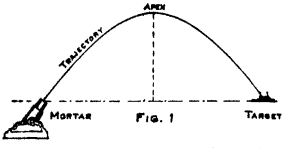


FIG. 1

A patented device, of which the writer is the inventor, takes scientific consideration of all the factors that enter into this problem. This device consists of a series of concentric rings universally mounted (that is, mounted on gimbals at right angles to each other) The center of gravity being considerably below the center of support, the inner ring assumes a horizontal position when symmetrically loaded. A telescope, with graduated arc and vernier, is mounted on the inner ring at right angles to the plane of the ring. The line of sight of this telescope therefore describes a vertical plane when revolved, enabling the operator to lay off the angle, *a*, for the particular height and speed used. Consulting Fig. 2, it is evident that, when the line of sight intersects the target, *T*, the projectile should be released

In order to solve the equation above given, it is

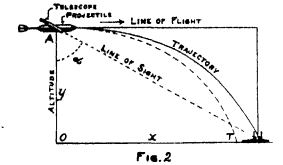


FIG. 2

necessary to know *v*, the velocity of the aeroplane *with respect to the ground* There is no instrument for measuring this velocity, it can, however, be readily determined by using the device above described

Consulting Fig 3, it may be seen that, when the angle *a* is 45 degrees, the distance *y* equals distance *x*

Therefore, in order to determine the speed over the ground, set the telescope at 45 degrees from the vertical and fly horizontally Knowing the height from the barometer, note when some conspicuous object, as a tree, crosses the field and start a stop-watch Then revolve the telescope to a vertical position and continue the flight to *B*, at which point the tree will again cross the field At this point, stop the watch

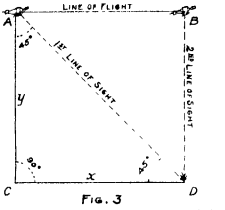


FIG. 3

The speed over the ground will equal the height divided by the elapsed time These speeds may be tabulated by taking all possible heights divided by all possible elapsed times It is apparent, also, that the whole operation will take scarcely more than a minute unless the height is very great

The "Hawke"-"Olympic" Collision

Experimental Investigation of the Cause of the Disaster

By Robert G. Skerrett

THE British naval authorities and the officials of the White Star Line are seemingly bent upon withholding from the public the essential facts regarding the collision between the "Hawke" and the "Olympic" on the 20th of September. Were the commander of either ship undoubtedly at fault in the handling of his vessel, it is not at all likely that the present policy of silence would be preserved, and this naturally suggests that there were conditions contributive to the mishap which were, in a degree, either unsuspected or beyond control of the commanding officers This suggested a line of investigation which, while not exactly new, is at present not thoroughly explored.

In April of 1908 the "Prinzess Irene" and the steamer "Parima" were outward bound in the lower bay of New York. The "Prinzess Irene" was bound for Europe, while the "Parima" was steaming for the West Indies The two ships were at least 200 feet apart, but following a comparatively narrow channel. Just before reaching a certain buoy, the "Prinzess Irene"—the bigger craft—began to lap upon the stern of the leading "Parima" Suddenly, the latter vessel was drawn to starboard and toward the "Prinzess Irene," while her bow fell off to port despite her helm and engines, and her head grounded There was no collision Some hours later the "Parima" was gotten off, but she was found to be leaking, and repairs costing about $40 000 were needed before the ship could put to sea

It was claimed at the time that the mishap to the "Parima" was due to suction set up between the two vessels in motion while proceeding on the same course. As a result of the unusual mishap Naval Constructor D W Taylor, U. S. N., carried on a series of experiments at the Government Model Basin in Washington. In substance, Naval Constructor Taylor found that when the overtaking ship began to overlap the other the disturbing force was of slight moment: there actually appeared to be a repulsion at both bow and stern, and, strange to say, the repelling forces acting upon the stern appeared to be greater than that exerted upon the bow of the following vessel—causing the stern of the latter to turn in toward the leader. As the over-hauling craft continues to creep up, the bow suction grows stronger, and the repulsion of the stern of this ship lessens—becoming, in fact, attraction when the two boats are abreast. Carrying the action through its natural sequence—the two boats proceeding—Naval Constructor Taylor discovered that there was a reversal of effects as the overtaking vessel assumed the lead: the bow suction diminishing rapidly while the stern became stronger—the latter reaching a maximum when the midlength of the overhauling boat was something like two-tenths its length ahead of the midships of the overtaken vessel. These disturbing forces are particularly potent in shallow waters, and the experiments at the navy yard in Washington were made under circumstances of depths which were calculated to diminish rather than magnify the measure of the suction as compared with the circumstances of ships passing through the ordinary channels approaching harbors Naval Constructor Taylor found by his model trials, when the two boats were in the position described by Prof Reeve, that the forces of attraction and repulsion were, in effect, directly opposite, i e, the bow of the overlapping boat turning in toward the midlength section of the craft afill in the lead

The correctness of Naval Constructor Taylor's conclusions can easily be verified and understood even if one has not at his disposal a model basin for actual tests In Fig 1 we have a pipe of variable diameter through which water is flowing in the direction of the arrows. At the points of maximum diameter, *P P* we have the full pressure of the head, while through the contracted section, *V*, we have increased velocity but *diminished* pressure Bearing the simile of this pipe and the varying pressures due to changes of diameter in mind, we can easily trace the action of the forces at play between two vessels where one is overhauling and overlapping the other In Fig 2, the smaller ship is within a short distance of the bigger leading one and abaft the beam of the latter Both vessels being in motion, the effect of the stream-line forces is a counterpart of current sweeping sternward. The hulls of the two ships form for us the adjacent walls of the pipe, while the relative nearness of the bottom on one hand and the water's surface on the other box in, so to speak, the stream-lines At the point *V* we have a restricted passageway for the current and, hence, reduced pressure and increased velocity of flow. This action may possibly be augmented by the propeller wake of the big ship At point *P* we have full pressure acting against the starboard bow while on the port bow at *V* there is a loss of pressure. Naturally the bow swings to the left and the stern in the opposite direction, drawing the smaller overtaking boat toward the larger one

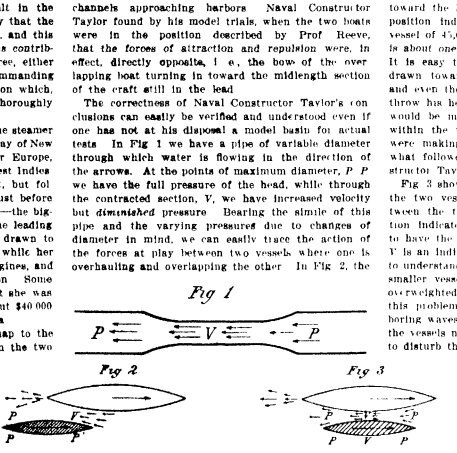


Diagram illustrating the "Hawke"-"Olympic" collision and its cause.

The accounts of the movements of the cruiser "Hawke" just prior to her collision with the "Olympic" seem to agree that the warship was crowded toward the liner and brought approximately into the position indicated by Fig 2 The "Olympic" is a vessel of 45,000 tons displacement, while the "Hawke" is about one-sixth as large and of much lighter draft It is easy to understand how the cruiser would be drawn toward the liner under these circumstances and even though the commander of the "Hawke" did throw his helm over the hydrostatic energy at work would be more than the latter's rudder could offset within the time available—especially if the warship were making considerable speed In Fig 4 we see what followed, and this bears out what Naval Constructor Taylor found to be the case with his models

Fig 3 shows us how the forces are distributed when the two vessels are directly abeam The space between the two boats is a counterpart of the condition indicated by the pipe in Fig 1 Assuming *P* to have the same force value in each instance while *V* is an indication of reduced pressure, it is not hard to understand how the resultant is a movement of the smaller vessel bodily to port and toward the bigger overweighted by *P, P, P* It is not necessary to confuse this problem with the crests and hollows of neighboring waves formed by the ships in motion In fact the vessels need not be moving at speeds high enough to disturb the water to this extent in order to arouse the suction needful to draw the vessels toward one another

It is quite likely that the disparity in size between the "Olympic" and the "Hawke" may have contributed to the disaster, because there was also a considerable difference in size between the "Prinzess Irene" and the "Parima" In the experiments made at the Washington Model Basin the models were of identical displacements It is fortunate that the collision between the warship and the liner occasioned no loss of life and if it were due to suction even admitting imprudence on the part of the naval skipper it is but another object lesson on a large scale of the care that ought to be taken under circumstances of this sort We must not forget the immense size of the "Olympic" and the majority of the ships now engaged in transatlantic passenger and freight service, nor must we overlook the steady development of speed in these big vessels Undoubtedly, both of these factors have an important bearing upon this question of suction, and these craft should be given a wider berth when in motion The mishap is fruitful of valuable suggestions and at the same time, it brings us to a realization of the stupendous energy latent in the water when the balance or equilibrium of the stream-lines is once disturbed

A Landsman's Log Aboard the Battleship "North Dakota"—II.

By J. Bernard Walker.

This landsman's log is written by the Editor of the SCIENTIFIC AMERICAN *as a preliminary to a magazine Naval Number to appear early in December, which will be comparable in its size and completeness with the Naval Number issued during the Spanish War. Alone respect it will be unique, for it will be written entirely by prominent officers of the Navy, each a specialist in the particular field that he covers. The leading article, moreover, will be from the pen of the Hon. George von L. Meyer, the Secretary of the Navy. The illustrations will consist of specially taken photographs taken during the recent maneuvers and target practice of the Atlantic Fleet on the Southern Drill Ground.*



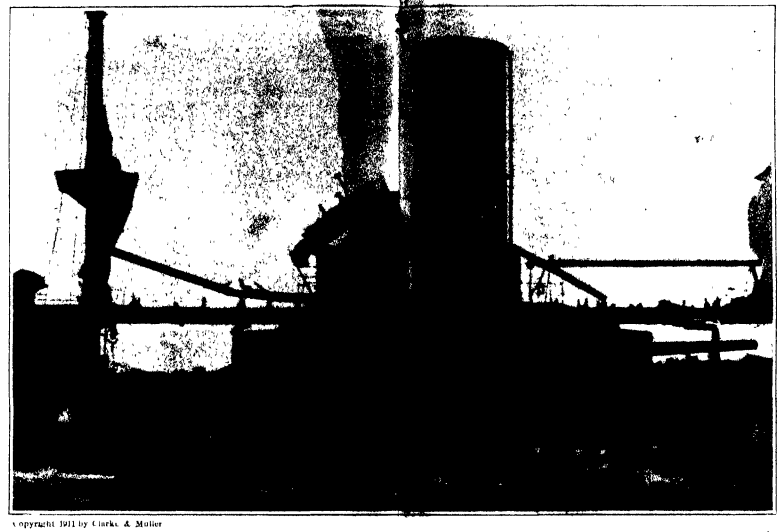
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"Crash goes the salvo, to be followed some twenty-five seconds later by the truly splendid spectacle of many giant geysers spurting high around the target."

"THE Admiral authorizes you to go aboard the Michigan to witness the firing of the Delaware against the 'San Marcos.' Boat leaves the starboard gangway at five o'clock." I rub the sleep out of eyes that are heavy with that slumber which only the sea can give, and turn to see an orderly disappear with a wireless message in his hand. Where am I? Why is the gray dawn coming through a square hole in the ceiling instead of through curtained windows in the wall? And why is that wall circular? Ah, yes, I am aboard the "North Dakota" and the circular wall at the foot of the bunk is the 10-inch barbette armor of her No. 1 turret (the officers' quarters are forward on this ship) and that 'window' is a square light in her forecastle deck, and those two black cylinders that I see above it are the forward pair of twelves; and ten minutes later I am gulping down a cup of coffee with half a dozen of our officers who have been detailed to the "Michigan," whence they will observe with critical eye the success or failure of the one particular rival of the "North Dakota"—her twin sister the "Delaware."

So we tumble into a steam cutter and a few minutes later are on the quarter deck of the Michigan," whose gun tompions (plugs which close the muzzles of the guns) have already been decorated with the coveted 'E' pennant with a black ball in the center which is carried by the ship that has made the best gunnery score in the annual Spring battle practice. The firing on the 'San Marcos" is to be carried out (as are all the major gun practices of our fleets) with a close approximation to battle conditions, and she will steam past the target "in division," that is to say, she will form one of a line of four ships, with the "Michigan" leading her. The wisdom of this policy must be evident to the veriest tyro if it means that, if ever the test of actual battle comes, it will present conditions with which the ship's company are largely familiar, the vital difference, of course, being the din and shock of such shells of the enemy as may land upon the ship. In the opinion of many naval officers the sound of shells that strike one's ship will be no louder than the stupendous crash of the ship's own salvos, and the shock to the ship as a whole of a striking shell can be no greater, surely, than that of the discharge of her own guns, which, I noted, shook the huge bulk of the ship as by an earthquake and made the masts, in the tops of which I stood, whip to and fro, for a moment, like reeds shaken in a wind. (This vibration lasts but a second or so. Long before the shells reach the target the platform is perfectly steady for observations by the spotters.)

But here, drifting lazily across our bow, comes the "Delaware," fresh from the Coronation Review, where she ranked as the largest and most handsome of the assembled warships. Stripped for action and with the light of dawn glistening down the long, lean length of her, this shapeliest of battleships looked for all the world like a huge torpedo-boat destroyer! The "Michigan" hoists her anchor home, gets under way, and passing to starboard of the "Delaware," leads her out to the course, two other battleships falling in astern to complete the division. We steam past the 'San Marcos," leaving her some miles to port. Soon we are fifteen thousand yards from the mark and still dropping her astern, while the far distant fleet resolves itself into a confused group of smoke-enshrouded masts and smokestacks. Still we keep going, until observations show the sunken ship to be some twelve to thirteen miles distant. The speed is raised to 15 knots, and a faint feather of foam parts at the stem and flows by the keen cutwater of the "Delaware." 350 yards astern. Then, over goes the helm and around swings the "Michigan," leaving a broad band of curiously foaming and twisting water in her wake. Splitting this in its exact center, the "Delaware" follows and in a few minutes we are straightened out on the course.



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"Poor old 'Texas'! At one time it looked as if your only mission in the fleet was to get into trouble, and stand as the butt for jests inside the navy and out. Well—you redeemed yourself in the Spanish war, and you have more than redeemed yourself in the information which you have furnished as to the inability of your fabric to stand up under the mighty hammering of modern ordnance."

And now the range-finders are trained upon the faint blotch that marks the position of the "San Marcos," and they tell us that we are some twelve miles from the target. The observer calls out the decreasing distances. "Twenty thousand yards"—"nineteen thousand, five hundred yards." "That is eleven miles," I say to myself, "and she won't be firing her ranging shot for another five or six minutes at least." But, glancing at the ship, I notice one of her forward 12-inch guns is rising slowly to near the maximum elevation of fifteen degrees. "Can it be possible that she is going to open up at a range of over ten miles?" I ask of a young ensign who is sharing a perch with me half way up the after cage mast. I am reaching for my camera when, white and swift as any lightning stroke, there burst a flash of flame from the gun, and the "ranging" shot is off on its ten-mile flight through the air. Up go our glasses on the distant "San Marcos." There is a wait of half a minute (it seems to one's tense nerves more like half an hour) when, apparently right at the wreck, there spurts up a vast geyser of snow-white water 200 feet into the air!

The observers on the 'Panther," which was anchored one thousand yards astern of the "San Marcos," stated that this trial shot landed only 75 yards short of the target! Think of the marvel of it all! High upon half a ton of steel launched into the air from a point about nine or ten miles distant, after describing a vast parabolic curve drops within less than 100 yards of the object aimed at! Then comes another flash—another long wailing cry of the swiftly spinning projectile—and another splash, this time one hundred yards over the target. And now for the salvo. One sees the ten 12-inch guns, which project across the starboard deck, move up like the black antennæ of some Brobdingnagian monster, as if feeling their way to the target. Crash goes the salvo, to be followed some 25 seconds later by the truly splendid spectacle of many giant geysers spurting high around the target. Fast and furious come the flash and the roar of the discharges. Now it is the foremost pair of twelves, then the aftermost, then a four-gun, and then a six-gun salvo. Over half a hundred shots are fired, all within a period of a few minutes, and many of them with an interval of only 30 seconds between rounds.

For the second time that day the courtesy of the Admiral is extended and the ship's cutter takes me over to the "San Marcos" for an inspection of the damage done on this and other days of firing. As I neared the old vessel, my mind went back to a visit made thirteen years ago aboard this ship, at the close of the Spanish war, when her captain took me down to the gun deck and showed me how the blast of her port 12-inch guns had dished the deck above, and showed me also the hole in her port bow, through which a shot from La Socapa battery at Santiago had entered the gun deck and caused one of the very few gunnery casualties of the war.

Poor old Texas! At one time it looked as if your only mission in the fleet was to get into trouble, and stand as the butt for jests inside the navy and out. Did I not see you one morning in the Brooklyn navy yard, lying ingloriously on the soft ooze of the dock bottom, into which you had deliberately settled in the night as the result of some one having left open one of your sea cocks. In those days, about everything in the calendar of mishaps that can occur to a ship seemed to come your way. Well, you redeemed yourself in the Spanish war, and you have more than redeemed yourself in the information which you have furnished to the Service regarding the inability of your fabric to stand up under the mighty hammering of modern ordnance.

As I climbed aboard it came to me that the last time I trod the main deck it was in the company of that fine officer of the older school, Capt

(continued on page 484)



"But here, drifting lazily across our bow, comes the 'Delaware,' fresh from the Coronation Review, where she ranked as the largest and most handsome of the assembled warships. Stripped for action, and with the light of dawn glistening down the long, lean length of her, this shapeliest of battleships looked for all the world like a huge torpedo-boat destroyer!"



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"The din of shells that strike one's ship will be no louder than the stupendous crash of the ship's own salvos; and the shock can be no greater, surely, than that of the discharge of her own guns, which, I noted, shook the huge bulk of the ship as by an earthquake, and made the masts, in the tops of which I stood, whip to and fro, for a moment, like reeds shaken in a wind."

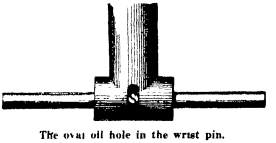
Suggestions for the Workshop

Ingenious Expedients of Resourceful Mechanics

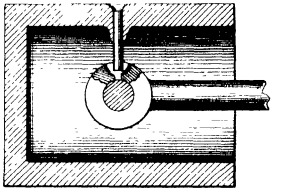
Lubricating a Wrist Pin

By F. E. Keller

OWNERS of gas engines, who have the horizontal type where the wrist pin is oiled by the cylinder lubricator by way of a hole through the shell of the piston, will in some makes of engines find much



The oval oil hole in the wrist pin.



Section through the wrist pin.

difficulty in keeping the wrist properly oiled thus resulting in excessive wear and a continuous knocking. The writer having had this experience, made use of the following kink, which worked perfectly. The hole in the piston was drilled out and a brass tube of proper length was fitted into it, as shown in one of the drawings. The oil hole in the connecting rod was cut to an oval shape to allow for the swinging movement of the rod. In operation the brass tube directed the oil down to the bearing, thus doing away with the splashing out ordinarily caused by the rapidly moving engine.

Carrying Water on Moving Trains or Boats

RAILROAD men frequently carry pails of water in the caboose and baggage cars. The motion of the cars would cause the water to slop did they not employ the kink here illustrated. On the water is laid a thin board circular in shape and a little smaller in diameter than the inside of the pail to prevent pinching or jamming. When the baggage master desires to wash his hands he simply presses down the board with his knuckles or finger, which gives him all the water he needs without removing the board. This scheme for carrying water in a pail could be used to advantage on a cruising boat or a motor boat.



The baggage master's pail.

A Spur Chuck for Wood Turning

By William Grotzinger

WHEN the ordinary chuck is used on small pieces of soft wood, there is a tendency for it to split the wood at its center. A spur chuck for soft wood, which will do away with splitting, can easily be made



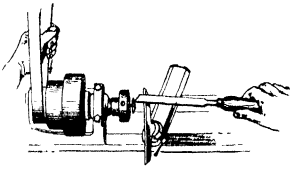
Spur chuck for small work

according to the drawing. A round channel is filed in the end of the square body of the chuck and a rectangular channel is filed crosswise. The four spurs thus formed have plane parallel outer surfaces, while the curved inner surfaces serve to compress the wood between them, instead of cracking it apart as in other chucks.

Removing the Waste on the Wood Turner's Screw Chuck

By F. B. Albert

WHEN the wood turner is turning drops or thin rosettes which are fastened on the screw chuck, there is not much wood left to grasp in removing. The wood turner, with the chisel resting on the rest, catches the point in the outer part of the rosette



Removing a rosette from the chuck.

on the back side of the lathe. With a quick pull on the belt with his left hand he revolves the lathe backward which readily unscrews the rosette from the chuck. All the stub pieces which are left on the chuck from other turnings are removed likewise.

Removing a Plug from Blind Holes

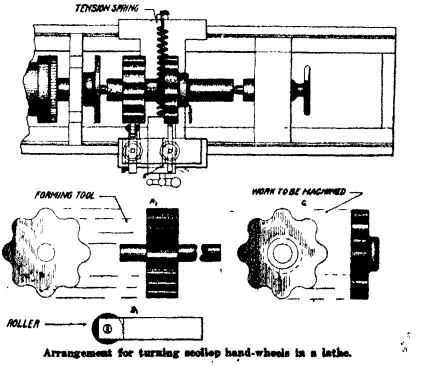
THE shank of a drill chuck was twisted off close to the end of the chuck, and it was quite a problem to get the end of the shank out, so the following little kink was tried. A ¼-inch hole was drilled endwise through the broken piece. The hole extended through the plug into the open space at the bottom of the hole. The hole was then filled with oil, and a ¼ inch pin was made, so it would slide freely therein. The pin was placed in the hole, and then was struck a heavy blow with a hammer, causing the oil that was at the bottom of the hole to force the plug out.

Turning Scollop Hand-wheels in a Lathe

By H. D. Chapman

THE accompanying engraving shows a practical little kink for turning scollop hand-wheels in a lathe. The writer once had a large number of hand wheels to be made as shown at *C*. The wheels were made of bronze and were cast. The outside diameter was to be machined so the job would look mechanical and it required too much time to file the wheels up, so this tool was devised.

The forming tool *A* was made of machine steel to the exact finished size of the hand wheel. A roller *B* was made of tool steel, and was of the same diameter as the radius of the scollop in the hand-wheel. Some slight changes were necessary in the lathe to accommodate the working of the tools. The feed screw on the cross-head of the lathe was removed and a coil spring was run from the cross-head of the lathe to the back of the carriage. This spring was made of No. 10 B & S wire, which was strong enough to control the cutting of the tool. A double tool post was rigged up and placed on the cross of the lathe carriage. The work was then mounted on the mandrel of the forming tool and placed on the center of the lathe, the roller *B* was placed in the tool post as shown at *D*; the lathe tool *E* was then secured in the opposite tool post *E*, and the lathe was started up. The roller *B*, which is shown in position at *D*, would roll over the scollop on the forming tool *A*, and by so doing would feed the lathe tool into the work in the same manner. A very neat finish was done on the hand-wheels in this manner in less than half of the time it would take to file them to a finish.



Arrangement for turning scollop hand-wheels in a lathe.

Facing Off an Elbow

By Albert F. Bishop

THE mechanic at times has very awkward things to hold while machining—an elbow for instance. The elbow is first placed in the chuck as in Fig. 1. A 2-inch L would need a short piece of shafting about three-quarters of an inch in diameter, sawed to a bevel on one end to fit roughly the outside sweep of

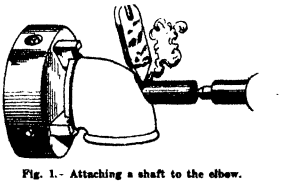


Fig. 1.- Attaching a shaft to the elbow.

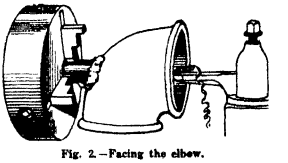


Fig. 2.—Facing the elbow.

the elbow. The other end should have a center, which the tail center holds central while the beveled end is tacked with solder to the brass or malleable iron elbow. It is then removed from the chuck, and the soldering is completed. Fig. 2 shows the short piece of shafting placed in the chuck, which holds the elbow firmly enough to face the flange ends and bore out or cut a new thread if desired.

Workshop Notes

Soapstone for Babbitt Casting.—When casting babbitt in molds or pouring babbitt boxes, powdered soapstone dusted in the molds or aperture for receiving the babbitt will very much improve the flow of metal, and you are quite sure of getting a full box or perfect casting.—L. M.

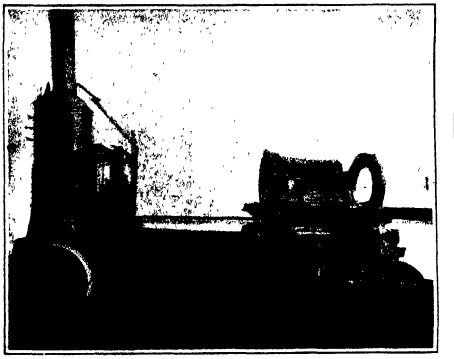
Preparing Metal for Painting.—In preparing for painting iron or metal which is quite smooth, or has been machined, say, for instance, a cylinder head, take raw oil and moisten a cloth so that a very slight amount of oil can be rubbed over the surface of the machined iron. Be particular not to get on too much, as it should be thoroughly dried before the paint is applied. It will take several days or a week for it to dry sufficiently. This preparation keeps the paint from chipping.—A. F. B.

The Inventor's Department

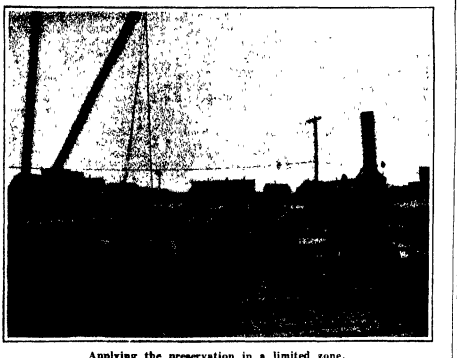
Simple Patent Law; Patent Office News; Inventions New and Interesting

Machine for Treating Poles With Preservatives

IT is at, or near, the ground line that a pole is most subject to decay, for here it is exposed to the moisture of the ground and to the air as well and hence provides an excellent breeding place for destructive insect life. In order to preserve the pole against decay, it is unnecessary to treat more than a limited zone in the neighborhood of the ground line. Recently a machine has been perfected by which the pole may be thus economically and expeditiously impregnated with creosoted oil, or other preservatives. The oil is forced into the wood by means of air pressure. The machine, as shown in the accompanying illustrations, is provided with a boiler for generating steam with which the air compressor is operated, and with which steam coils are heated to warm the oil that is stored in a reservoir in the middle of the machine A pair of iron skids will be observed extending crosswise of the machine, and upon these the pole is supported. Two iron rings, shown in the illustration, may be opened to admit the pole, after which they are closed by operating a hand wheel. A spool, bearing a canvas band three feet wide, is then revolved by a hand wheel so as to wrap the cloth tightly about the pole. The edges of the band are reinforced to make a snug fit and they are subjected to air pressure, so that the band will form an airtight annular bag about the pole. This done, the heated oil is introduced into the bag through a pipe under a pressure of about five pounds to the inch It has been found under test that a 10-minute treatment is sufficient to force about a gallon of oil into the pole The oil is forced into the wood to an initial depth of three-sixteenths of an inch, but it continues to penetrate the wood after the pressure is relieved, and at the end of a few days reaches a depth of about one-half inch After the pole has been treated, the spool is revolved to unwrap the cloth band from the pole, the rings are opened and the pole is rolled off the opposite end of the skids A pan is located under the band to catch any oil that may drip from the cloth, or that might ooze out through checks in the wood during the treatment The machine shown in the illustration handles poles from seven to twenty-four inches in diameter



Machine for impregnating poles with creosote



Applying the preservation in a limited zone.

The Heany Tungsten Lamp Cases

ONE of the most interesting decisions in the history of the United States Patent Office has recently been handed down by Hon Cornelius C Billings, the First Assistant Commissioner, culminating a long and arduous series of hearings and examinations before him, the taking of testimony of many witnesses and the delivery of arguments by many noted counsel.

The investigation of the Heany applications was altogether unique so far as precedent in the Patent Office was concerned It was the direct outcome of the famous Heany criminal trial, in which John Allen Heany, Ned W. Barton and Henry E. Everding were tried for fraudulent manipulation of records in the Patent Office. The applications involved the alleged invention of tungsten filaments for incandescent lamps, and for the process of making filaments from metals in a colloidal form.

Certain charges made by Principal Examiner A. F Kinnan, of Division 37 of the Patent Office, were the basis of the investigation, concerning applications serial numbers 225,769, 332,786 and 344,-068, filed by John Allen Heany; of charges relating to the said Heany application No. 238,769, and its alleged divisional application No. 344,068, set forth in the petition of Hans Kuzel, who is involved with Heany in interference No. 27,073, and of charges concerning said Heany's application, No 238,769, and its alleged divisional application, No. 332,786, set forth in the petition of Kuzel, Just and Hanaman, and von Bolton, who are involved with Heany in interference No. 27,074.

It was charged that Everding, a patent attorney, and Barton, an assistant examiner, in the year 1906 removed from the parent Heany application, certain sheets of the original specification and substituted other sheets, containing matter not in the original specification, when filed in 1904, and the matter contained in these substituted pages, it was alleged, was compiled by Barton, from information gained through his position in the Patent Office. It was charged that Heany aided, abetted and connived at the acts of Everding and Barton in this fraudulent substitution.

It having been shown that Barton and Everding were guilty of fraud, and they having been punished therefor, Barton having confessed before the criminal trial, and Everding being convicted, and, although Heany himself was acquitted, the charges made in 1909 by Examiner Kinnan led to the institution of the very exhaustive investigation which has just been finished, and which occupied a period of about one year. The investigation had for its purpose to decide whether, in view of these substitutions and changes, valid patents could be granted, or whether the applications should be expunged from the files on the ground that they were fraudulent.

The taking of testimony was commenced before the First Assistant Commissioner of Patents on July 25th, 1910, all parties being represented, and was continued from time to time, and finally concluded April 21st, 1911 Respondents were given ample opportunity to cross-examine the witnesses produced in support of the charges and to rebut their testimony, and availed themselves of that opportunity Voluminous testimony was taken by both sides which was supplemented by stipulation into the record of certain testimony previously taken in the criminal trial

This proceeding grew out of a condition of affairs in the Patent Office which has occurred for the first time in its history So free from fraud or allegations of fraud has the Patent Office been, that no statute or rule of practice is found to cover specifically such a case The effort of the First Assistant Commissioner was to learn by due process of law, the truths surrounding the case and to render a judgment based upon those truths in accordance with the law.

Jurisdiction of the case was acquired by virtue of the general supervisory authority of the Commissioner of Patents over affairs in the Patent Office, its records and papers, which empowers him to grant valid patents upon legally effective applications therefor, or else to refuse to grant patents upon applications therefor, which are shown to have no foundation in law, and which patents, if granted, would, in his opinion, be null and void

The gravity of the charges preferred against the Heany applications by Examiner Kinnan, and the tremendous commercial value of the inventions involved, the control of which, upon the granting of patents would undoubtedly cause millions of dollars annually to accrue to the profit of the owners thereof, led to the absolute necessity for the discovery of priority of invention, and, if possible, to decide without a vestige of a doubt, which of the contending parties was entitled to status in the interference

In his decision in this proceeding, Mr Billings said

"It would be a travesty indeed, and against all legal principles to permit a party to an interference to remain a party thereto should it be found that the very applications of that party involved in the interference are fraudulent to such a degree that no valid patent could be granted based upon such applications or, in other words that any patent or patents granted upon such applications would be in valid and void on the ground of fraud A fraudulent application is in law no such application as to justify the grant of a patent thereon and the same is true when an application contains an incomplete and inoperative disclosure

During the progress of the investigation it was urged on behalf of the respondents that the question as to whether or not John Allen Heany was guilty of the fraudulent practices concerning his applications, was *res adjudicata* because of Heany's acquittal in the criminal court of the District

The Court of Appeals of the District of Columbia, which is the court of final resort in patent jurisdiction and is also the court which hears and determines appeals in patent cases from the decisions of the Commissioner of Patents, held that the power of the Commissioner to declare that the altered application is not "the application contemplated by the statutes as the foundation of the patent," was not barred by the adjudication in the criminal case," and said

"If he (the Commissioner) finds the alterations to have been made but without knowledge and consent of the applicant he will permit it to be corrected so as to restore it to its condition as originally filed

And also

If on the other hand he finds that it was tampered with by the connivance and approval of the applicant, he will probably enter an order refusing the application leaving the applicant his right to appeal therefrom

After fully and exhaustively considering the citations offered by the respondents, the First Assistant Commissioner held that the question of Heany's complicity in the frauds charged is *not res adjudicata* in the proceeding

Mr Billings touches briefly in his decision upon the introduction during the investigation of a mass of evidence by Heany, which was subsequently found to be manufactured under Heany's direction, for the purpose of proving that he (Heany) had invented a pure tungsten filament meandescent lamp prior to December 29th, 1904, the date of filing of his application, No 238,769, and to substantiate the contention that he had no motive whatever in perpetrating the frauds specified in the charges and admitted by respondents in their answers, to have been made in said application

During the investigation it was largely due to the efforts of the First Assistant Commissioner that the spurious nature of this so-called evidence was discovered, in which efforts he was greatly aided by the counsel for the respondents, who were unaware of the character of the evidence, and who demanded that the witnesses

whom they had presented should tell the entire truth no matter how damaging in effect it might be for their clients.

If, therefore, transpired that instead of showing that Heany could have no motive to perpetrate the frauds alleged, the evidence introduced on the contrary, shows that Heany did not have a conception of the uncertainties of the issues within the meaning of the patent law, prior to the filing of his application on December 29th, 1903, and that he did have a decided motive in attempting to obtain the benefit of that date for knowledge subsequently acquired.

The decision of the First Assistant Commissioner, therefore, in effect orders the dissolution of the interferences Nos 27,074 and 27,075, as to the party Heany, and directs that the amendment present to the parent application of Heany, No 2,48,769, filed December 29th, 1903, be refused entry and the application finally rejected, and a patent on that application finally refused on the ground that any patent granted thereon in view of the established facts would be held in the courts to be null and void and of no effect, on the ground of fraud.

The amendments presented in the "tungsten division" application, serial No 332,786, filed August 31st, 1906, are refused entry and the application is finally rejected and a patent thereon is finally refused, on the ground that any patent granted thereon in view of the established facts would be held in the courts to be null and void and of no effect, on the ground of fraud. Similar action is taken with regard to the "colloidal division" application, No 344,068, filed November 19th, 1906, and the amendment thereto.

The First Assistant Commissioner further ordered that upon the termination of the proceeding, each of the three Heany applications shall be endorsed with the words "Patent refused on the ground of fraud," and each of them shall hereafter be kept in the archives of the Patent Office, separate from the other applications for patent.

The inventions involved in the issues not only of the Heany applications, but in those of the interfering parties, are perhaps among those which claim the greatest public interest. The tungsten lamp, which is being universally adopted and which combines a higher efficiency with a lesser cost than the ordinary carbon filament incandescent lamps, is a possession the control of which is well worth the terrific legal struggle which has taken place both within and outside of the United States Patent Office.

Notes for Inventors

Some New Gayley Steel Process Patents.—James Gayley of New York city has secured a patent, No 1,002,576, for apparatus for drying air by refrigeration, and patents, No 1,002,577 and No 1,002,578, for methods of drying air, both of which include the refrigerating idea.

Short Claims in a Patent. Patent No 1,002,048, to Fred B Corey of Schenectady, N Y., assignor to General Electric Company, for a relay contact, is interesting because of the brevity of its claims. It has two claims, the first containing only six words and the second only seven words the second claim being identical with the first except for the addition of the word "malleable."

An Alarm for Cash Box of Pay Telephones.—In patent No 1,002,232, to William E Davison and Robert McAlpine of Detroit, Mich., is shown a telephone instrument and a cash box for the telephone and having a lock with an electric alarm which operates when the lock is unlocked or when the telephone instrument is detached.

A Cool "Bite" for Infants—Women with teething babies will be interested in a patent, No 1,002,364, to Josiah H Bridges, which shows a cooling receptacle and a hollow, imperforate mouthpiece whose interior communicates with that of the cooling receptacle so that the mouthpiece which the infant bites will be kept cool, and the receptacle has a non-conducting jacket which prevents the infants hands from coming in contact with the cold body portion

Women in the Patent Office Examining Corps.—One woman represents her sex on the examining corps of the Patent Office. For some years Mrs Noyes and Mrs. Lybrand were assistant examiners and became well known to most practitioners before they resigned their positions some years ago. Now the only woman on the force is Miss Marie K Saunders, a native of Missouri. She was assigned to the Patent Office August 3rd, 1901, as a copyist at a salary of $900 per annum, being appointed from Guthrie, Okla January 11th, 1907, after passing the rigid Civil Service examination for the position, she was appointed a fourth assistant examiner at $1,200 per annum, her salary being increased by operation of law on January 1st, 1908, to $1,500. On November 1st, 1909, she was promoted to be a third assistant examiner at an annual salary of $1,800 and still holds the position

Helping the Dentist.—A number of dentists have spoken to us about the desirability of an improved cement for certain classes of dental work, such, for instance, as setting inlays. It should be transparent, strongly adhesive, insoluble in the liquids of the mouth, quick setting, and be non-irritant to the pulp of the tooth. They also referred to the need of a gold preparation which can be worked with the same speed and facility and under the same conditions as the ordinary silver base alloys, or amalgam. Another thing desired by dentists is an abscess syringe, so constructed that it may be used in any position in the mouth for injecting fluid medicaments through the roots of teeth into abscess tracts. It should be so formed that the needle can be packed in position in the desired root with the barrel in such relation to the needle that pressure can be made in the barrel at a distance from the mouth and without force or strain upon the needle.

Ancient Inventors and their Secrecy—It is an interesting fact that the inventors of ancient times, while appreciating public patronage, described the uses and merits of their inventions instead of explaining the operations and principles thereof. In other words, while they enlarged upon the great things that could be accomplished by their inventions, they carefully concealed the means and modes of operation by which the results were to be accomplished. In the early days patents were often regarded as unrighteous monopolies and the patentees were held in great contempt. This prejudice would probably never have existed if patents had been confined to new inventions, but in those days exclusive grants were obtainable to control the manufacture and sale of the commonest articles in daily use. So objectionable did this practice become that the wrongful monopolies were held up to public ridicule and an old writer, Maitland, says in the "Antimasque of Projectors rode a fellow upon a little horse with a great hat in his mouth, and upon the man's head was a bit with headstall and reins fastened, and signified a projector who begged a patent that none in their kingdom might ride their horses but with such bits as they should buy of him. Then came another fellow with a bunch of carrots upon his head, and a capon upon his fist, describing (representing) a projector who begged the patent of monopoly as the first inventor of the art to feed capons with carrots and that none but himself should make use of that invention, and have the privilege for fourteen years, according to the statute."

Inventions Ahead of the Times—Frequently inventions are made before the time is ripe for them to go into general use. This is illustrated in the so-called fireless cooker which has recently come into popularity and is now used to a great extent. The fundamental idea of this cooker is not at all new, the apparatus in its main features being described in Ganot's physics as a Norwegian stove, no illustration, however, accompanying the description, at least in the edition we examined. Patents were also granted many years ago, both in the United States and England, for fireless cookers. In the English patent, No 778, of the year 1857, a Frenchman, Joseph Francois Marros of Paris, describes the invention as consisting in putting the food to be prepared for eating with water and suitable condiments, in a cooking vessel of the digester kind, which vessel is placed on the fire and the temperature is raised as high as two atmospheres or about 121 deg C, indicated by a suitable valve, fitted on the lid of the vessel. When the valve is raised and steam escapes, the vessel is taken from the fire and put in a double wrapper case which is packed with suitable insulating material, and the cooking keeps on until it is completed by the confined heat, sometimes five or six hours or more. In this form of cooker, the food is brought to a cooking heat in the vessel before the latter is placed in the insulating casing. In a United States patent, No. 59,441, of 1866, expired long since, the cooking vessel is placed in the insulating casing with a chamber around the vessel and in which chamber hot or boiling water is placed so the heat from the water will slowly cook or stew the meat or vegetables placed in the vessel. This old idea is somewhat similar to that pursued in some of the modern cookers in which radiators in the form of plates are heated and placed in the casing adjacent to the vessel containing the food to be cooked. Most of the earlier patented cookers describe the apparatus as adapted for use as a refrigerator as well as a cooker.

A Swinging Emery Wheel.—A very interesting and novel feature to be seen in a few of the most advanced machine shops is a swinging emery wheel. The wheel and the motor which drives it are mounted together and are suspended from the ceiling and the lower part of the wheel is exposed while the upper portion is shielded by a hood for the protection of the workman. The outfit is suspended by means of a bar, on one side of which is the motor which balances the emery wheel secured at the end of a four-foot shaft. The apparatus may be raised or lowered to any desired height to suit the character of the work, and as it is thus suspended, the operator manipulating the wheel by two arms extending from the hood, it is possible to move the wheel over an area of eight feet. This installation is designed principally for the purpose of finishing heavy pieces of work which cannot be readily moved back and forth over the stone. The connection between the motor and the wheel is direct, and as there are no belts or chains, this advantage is great. The device is intended to withstand hard usage. By this arrangement delays due to belt failure are entirely avoided.

A New Automobile Fire Engine.—The Springfield fire department has displaced a team of three horses, formerly attached to one of the water towers, and this piece of apparatus is now drawn to and from fires under power without any further alteration or change than the removal of the front wheels. For this purpose a "dreadnaught" was made use of which is a sturdy little motor, mounted on a truck, adapted to support the front end of the water tower, and equipped with a motor of sufficient power to draw it rapidly to the scene of action. In order to permit of its making very short turns and of winding through narrow thoroughfares, the front wheels of the tractor are mounted so close to each other that it has the appearance of a single large wheel.

Automatic Gas Cocks.—Although we frequently read of deaths from accidental gas suffocation, it is found that many patents, probably several hundred, have been granted for devices for automatically shutting off a gas cock if the gas be blown out or accidentally extinguished. An early, if not the first, patent for this subject is the patent, No 71,440, to Smith, issued February 11th, 1868, and long since expired.

RECENTLY PATENTED INVENTIONS.

These columns are open to all patentees. The notices are inserted by special arrangement with the inventors. Terms on application to the Advertising Department of the SCIENTIFIC AMERICAN.

Household Utilities.

CLOTHES DRYING FRAME.—J. W. Hoxsie, Chicago, Ill. This invention supplies a frame for use within the confines of a dwelling it is particularly arranged to elevate the drying frame and the articles suspended thereon from the floor, and if the room in which the frame is installed permits, above the heads of the occupants of the room to allow persons to pass beneath the frame and the clothes.

Electrical Devices.

INDUCTION COIL.—J McIntyre, Jersey City, N J. In this improvement the induction coils an adjustment of the contacts is obtained in an effective manner, according to the use to be made of the apparatus and relative to the existing strength of the source of electrical energy, the arrangement regarding the employment of the expensive platinum contacts exceedingly economical. It relates to electrical apparatus in Letters Patent of the U. S., twice granted to Mr McIntyre. He has also invented another induction coil, and it relates to electro-magnetic apparatus, its object being to provide certain improvements in the Ruhmkorff and other types, whereby a non rotatable contact is bodily moved with its bearing on the bridge or post, to bring this contact in proper relation to the opposing contact and to securely lock the movable contact and its bearing in the adjusted position against accidental movement

Of General Interest.

APPARATUS FOR PRODUCING VARIOUS SOUND EFFECTS FOR THEATRICAL AND LIKE PURPOSES.—A H Musgrave, Victoria Works, Bagley Street, Bradford, England. This invention relates to apparatus for producing various sound effects for theatrical and like purposes, the apparatus being particularly advantageous for use in combination with kinematographs and the like, for imitating the sounds that would be produced in the scenes that are being depicted. The details may be varied to suit particular requirements. It may be operated by one or more electric motors with switches or control handles for the different effects.

MAIL BOX AND CARRIER.—H A Schmitz, Dorchester, Wis. This invention has in view a box in which the mail is well protected from the weather and readily introduced and removed, and further and principally resides in the mounting of the box so that it is accessible to the carrier without leaving the road, and also accessible from the premises at a substantial distance from the road the box and its carrier offering no substantial obstruction to travel along the road, but adapted to swing from a position over hanging the road to a reversely extending position.

PEANUT ROASTER.—L. Roenkeraus, Rhinebeck, N Y. This invention pertains to roasters for peanuts and like products, and has reference more particularly to a device of this class, which comprises separable casing sections, a roaster removably mounted between the sections, and a burner under the roaster, the casing having a warmer therein above the roaster.

SHOEMAKER'S JACK.—F O Rollins, Newburyport Mass. In this case the improvement refers to shoemakers' jacks, and the object is to produce a jack having great durability, which will be adjustable so as to change the height at which the shoe is held, and also to enable the shoe to be held either at the right or at the left side.

FLASH LIGHT APPARATUS.—H J Paul and F Kuhn, New York, N Y. This invention refers more particularly to photographic and like apparatus which comprises a support, a frame carried thereby, an envelop supported by the frame, for confining the smoke and other products of combustion of the flash light material, and a slide mounted upon the support and connected with the envelop so that the last can easily adjust itself to the expansion due to the explosion.

TRAY.—C A Anderson, East Orange, N J. The front end of the tray extends upwardly at an obtuse angle relatively to the bottom of the tray to form an abutment which will normally retain slips of paper in the tray, while readily permitting the user to slip the uppermost slip of paper over the inclined front end of the tray by placing the thumb against the extension of said front end formed to retain a pencil, and his first finger on the uppermost slip of paper.

SOLDERING APPARATUS.—W. W. Farnsworth, Brushton, N Y. This invention refers to improvements in devices for soldering parts, especially parts of jewelry, optical goods, etc. It provides means by which two small parts may be held rigidly, while the soldering is conducted. It provides a small pad of heat insulating material, which may be held in the hand while parts to be soldered may be securely held upon the pad by devices which may be

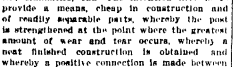
easily manipulated to release or retain the parts to be mended

METHOD OF DISINFECTING BOOKS—I. H. Hoon, 113 Poplar St., Greenville, Miss. This method consists in spreading or opening the leaves of the book by a blast or current of air, and in simultaneously delivering to the spread or opened leaves a disinfecting substance by the same current of air. The books may, however, be treated in the same manner, separately or in lots, by passing the blast backward and forward over the books, and by reciprocating the books through the blast or current of air

FEED TROUGH.—W RANDALL, Los Angeles, Cal. The object in this instance is to provide a simple and inexpensive trough wherein but a small amount of food is exposed at once, and wherein as the exposed food is removed the supply is renewed. A constant supply of food is obtained Four kinds may be fed at once

FENCE POST.—J. E HUSSEN, 526 Hoffman St., Hammond, Ind. The intention here is to provide a means, cheap in construction and of readily separable parts, whereby the post is strengthened at the point where the greatest amount of wear and tear occurs, whereby a neat finished construction is obtained and whereby a positive connection is made between the wires and the post

TOBACCO SMOKING PIPE—SAMUEL E CRASSEY Alfred, Maine This invention provides a stem for a pipe pivotally connected to the bowl thereof to permit the swinging of the bowl to a position parallel with the stem, provides in the pipe a bifurcated extension for the stem to form a yoke for the bowl, and provides an automatic cover for the bowl operative when the same is disposed in housed



TOBACCO SMOKING PIPE

position The invention forms a double armed stem section having in one or both of the arms the necessary smoke channel, which unite to form a single channel for the mouth piece, and in pivotally connecting the arms and bowl It provides a convexed cover guidably mounted in structure of arms and spring actuated to normally extend into the path of the pipe bowl when swung to housed position The illustration presents a side view

COLLAPSIBLE CONTAINER—T. F. TASNEY 447 W 14th St., New York, N Y The invention pertains to a container of a type adapted to contain cigarettes or the like It can be made from less material and with less trouble than those now on the market The container can be collapsed as the articles are used so that a bulky package need not be carried about when the container has therein only one or two of the articles

MINIATURE GREENHOUSE—F W SCHWARZ, 492 S 3rd St Columbus, Ohio This device can be made in any size required and put into use in any garden or field The parts thereof are hinged to one another so that the whole structure can be taken down and stored away so as to occupy a minimum amount of storage room

Hardware and Tools.

PIPE WRENCH—W L. BESSOLO, Box 522, Birmingham, Ala The invention consists of a handle upon which is mounted a jaw member so that it has a limited degree of rocking movement With this jaw member is pivotally connected a jointed member exteriorly toothed to interlock with a spring-actuated pawl also pivotally mounted on the shank member and upon the rocking jaw member When the last is moved in one direction the co-operating jaws are made to tightly grip the pipe interposed between them through means of the pawl, while when the rocking member is moved in opposite direction the space between the jaws allows the wrench to be turned on the pipe to get a new hold

MARKING TOOL.—J A WICKES, 64 Broadway, East Somerville, Mass. This invention provides a tool with marking faces having corresponding oppositely extended distinguishing features; provides in a marking tool a plurality of hammer heads bearing distinguishing marks identifying the character being printed, and provides for a tool for accurately and quickly distinguishing the correct position of the character imprinted

SHEAR GUIDE.—T H. SUZUKI 1031 Washington St., San Francisco, Cal The object here is to construct a device wherein a blade is held in adjustment against a sharpening stone in such a manner as to allow of a free swinging movement of the edge of the blade across the sharpening stone. The inclination of the blade on the stone may be varied at will, and held at its adjusted position Means are provided whereby the stone will always be kept in contact with the edge of the blade.

Machines and Mechanical Devices.

PULLEY AND BEARING THEREFOR—M H AVERY, Dover, N H This invention provides oiling devices for pulleys arranged for continuous circulation of oil from the center to the end of the bearing and return, provides a construction for pulleys whereby to avoided dropping of oil from the pulley or bearing therefor, and provides an oil distributing and lubricating bearing for a loose pulley

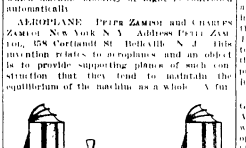
SUGAR BOWL.—I MATAS, Patterson N J The purpose here is to provide a bowl designed for use in restaurants, hotels and other places where sugar is placed at the disposal of patrons, and having mechanism inside the same to enable the sugar to be readily and easily discharged from the bowl into a glass or other, receptacle without necessitating the use of spoons

FLYING MACHINE PARACHUTE—J W DODSON, New York, N Y It is one of the objects of this invention to provide a parachute which will correspond to a lifeboat on a water vessel, and enable the aviator to detach himself safely from the aeroplane in case of accident to the latter The parachute may be extended and let out any distance from the aeroplane, so as to aid in supporting the same, if necessary, and to act as an air anchor

COPING MACHINE—J G BENSTER and H L. BENSTER, Moline, Ill This invention has reference to cutting and punching sheets and bats, and its object is the provision of a new and improved coping machine more especially designed for shaping the ends of I beams channel beams and other beams used in structural steel work, to insure close fitting of adjacent members at an angle of 90 degrees or less, as the case may be

FLYING MACHINE—M G ADAMS, Parsons, Kan This invention more particularly relates to a machine in which a steering surface such as a rudder which is manually or otherwise operable is controlled by a further surface which is free to move under the influence of air pressure thereagainst The stability of flight of the machine is automatically controlled Mr Adams has invented another flying machine, in which is provided a steering surface or rudder, and a controlling surface operatively connected with the steering surface and arranged to move bodily under the influence of air pressure thereagainst and in which machine stability of flight is controlled automatically

AEROPLANE—PEIPE ZAMBINI and CHARLES ZAMBINI New York N Y Address PEIPE ZAMBINI, 358 Cortlandt St Belleville N J This invention relates to aeroplanes and an object is to provide supporting planes of such construction that they tend to maintain the equilibrium of the machine as a whole A fun-



AEROPLANE

ther object is to provide supporting planes and side planes so disposed toward one another that not only is the equilibrium maintained but each serves as a lifting or resistance element Means are provided for protecting the ends of the supporting planes in case they should dip downwardly and come in contact with an obstacle in its path The engraving shows a plan view

Prime Movers and Their Accessories.

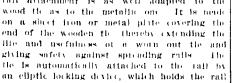
STARTING DEVICE FOR INTERNAL COMBUSTION ENGINES—R O LE RASON Masonic Temple, Portsmouth, Ohio The object here is to provide means which may be used at will to connect an auxiliary gas tank with the intake of the engine, so that the gas will mix with the explosive mixture and flow into the engine cylinder, which with a proper speed mechanism will insure an explosion in the engine cylinder on the first or in any case on the second, rotation of the engine shaft

MEANS FOR COOLING INTERNAL COMBUSTION ENGINES—R F. E CHAVEZ Antigua, Guatemala In the present patent the object of the invention is the provision of a new and an improved means for cooling internal combustion engines in a more efficient economical manner, and for this particular purpose use is made of moistened air moved in contact with the cylinder of the engine

Railways and Their Accessories.

RAIL JOINT—F C BOYAMIGHT, Philadelphia, Pa This invention has reference more particularly to a rail joint which comprises a base having rail engaging means, a chair movably mounted upon the base and adapted to support the rail ends, means for causing the relative lateral movement of the base and the chair to secure the rail ends in position, and means for holding the rail ends.

METALLIC TIE AND RAIL FASTENING DEVICE—JOEL F. ROBINSON, Central, S C This device eliminates the use of spikes which split the tie, work loose, and otherwise destroy its life and causing many wrecks The rail attachment is as well adapted to the wood tie as to the metallic one It is made on a short iron or metal plate covering the end of the wooden tie, thereby extending the life and usefulness of a worn out tie and giving surety against spreading rails The tie is automatically attached to the rail by an elliptic locking device, which holds the rail



METALLIC TIE AND RAIL FASTENING DEVICE

immovably, guarantees an exact gage of track and is assable only in the use of a wrench The locking device is underneath the rail and inaccessible to train wreckers It is not liable to be disturbed by any cause until a wrench is used The form of tie is especially adapted to elevated wayides and on ballast roadbeds The invention provides for insulation, and the engraving shows a top plan view

CAR TRUCK—C A LEGGETT, Wayne Maine The object here is to provide trucks for railroad cars constructed and arranged to dispose the axles of the wheels in a radial position upon the curved sections of the track in order to eliminate friction at these curves A further object is to so arrange the trucks that any obstruction upon the track would not tend to cause the wheels to leave the roadbed

DOOR FOR GRAIN CARS—I W WHITTIER Palmyra, Neb This invention relates to a door for grain cars coal cars and the like One object of the improvement is to provide a door which can be readily and easily fastened to the framework when in use and may readily be swung out of the way when not in use, and further provides means for attaching the door to the framework on the car in both of these positions

WATER GAGE—J A COOPER Jersey City and W R VAN BUSKIRK, Patterson N J This invention provides a water gage for determining the level in boilers especially on locomotives The gage is strong and durable and is not liable to blow out and even if it should blow out the fragments of glass would be caught by a protector, preventing them from flying and in injuring the person or eyes of the engineer

DOOR HANGER FOR CAR DOORS—J T GRIMSHAW and L. E WILLINGTON Rialto Cal An object in this instance is to provide a hanger which will permit the car door to be easily opened and closed and which will make the binding of the door impossible A further object is to provide a device having a novel form of adjustment for the same purpose, whereby closing the door together with means for preventing wear of the attachments

Pertaining to Recreation.

SWING.—G D TUCKER Markham, Miss An object of this invention is to provide a support for a swing rotatably supported on suitable rollers with means for holding one or more of said rollers by the swinging action of the swing so that the device as a whole will move over the ground and if desired above a common pivotal point

GAME APPARATUS.—I E YOST care Yost Yost Co Arkansas City, Kan An object of this invention is the provision of a new and improved game apparatus for playing a game of checkers on a map in the use of traffic tools or the like more or less as done by the couple as points to move to and towns at the end of the map a King for The game is likewise interesting and educates in geography

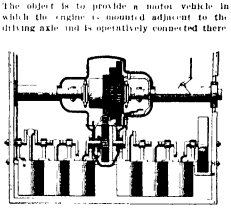
Pertaining to Vehicles.

PNEUMATIC WHEEL.—S P COX Bergen N Y This inventor provides an improved construction of wheel in which the tire is made up of separate units each carrying its own pneumatic cushion and the individual tube for each associated with the cushion the various units being removable at will and consequently interchangeable

BRAKE LOCK.—W S HARRIOT Anthony Ind. To accomplish the purpose of this invention use is made of a brake lever for connection with a brake shoe, a locking tool mounted on the brake lever, a locking lever adapted to be engaged by the locking tool to lock the brake lever relatively to the locking lever and means for limiting the movement of the locking lever

VEHICLE WHEEL.—J C THOMS, Burke Idaho The aim in this case is to provide a novel construction of spring wheel which will have sufficient resilience to permit its practical operation on automobiles and the like without pneumatic tires An important feature of the invention is the coiled portions of the spokes which give greater resiliency to the spokes and thus improve the action of the wheel

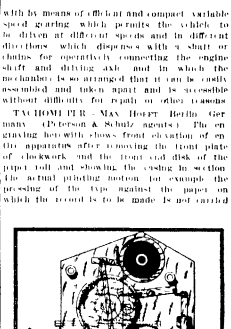
GEARING.—HOWARD G CARR, 910 E Main St Hoopeston, Ill This invention is shown in the enlarged plan view of the chassis of a motor vehicle exhibiting the engine for driving the vehicle and in cross section, the gearing connecting the engine and the driving axle The object is to provide a motor vehicle in which the engine is mounted adjacent to the driving axle and is operatively connected there



GEARING

with by means of efficient and compact variable speed gearing which permits the vehicle to be driven at different speeds and in different directions which dispenses with a shaft or chains for operatively connecting the engine shaft and driving axle and in which the mechanism is so arranged that it can be easily assembled and taken apart and is accessible without difficulty for repair or other reasons

TACHOMETER—MAX HOERT Berlin Germany (Peterson & Schulz agents) The engraving here with shows front elevation of one the apparatus after removing the front plate of clockwork and the front end disk of the paper roll and showing the casing in section The actual printing motion for stamping the pressing of the type against the paper on which the record is to be made is not carried



TACHOMETER

out by a clockwork spring or weight adapted to be wound up periodically but either by coupling the printing mechanism with a shaft or some other part driven by the motor or by force of the person moving some operative part of the vehicle or motor Printing is thus effected with the great accuracy and the apparatus can not fail owing to insufficient force being an eliable as is occur when a clockwork spring is used The complicated mechanism heretofore necessary in order to automatically wind up a clockwork spring is now avoided

DOOR SIGNAL.—L L. BOGUS San Francisco Cal The object of the present invention is mainly to provide an automatically acting indicator device actuated by the closing of the door This device is particularly adapted for use on automobiles and other vehicles and at all times to see that the door is opened or closed without turning his head

SLEIGHING ATTACHMENT FOR CARRIAGES—I P MCCRACKEN Berlin N H This attachment is for use for baby carriages go cart and vehicles in general and it comprises a plurality of runners which can be suitably supported beneath the body of the vehicle and adjustably attached thereto so that they can be in inferior clear of the ground when they are not needed for use or lowered when desired to support the weight of the vehicle thereon

Designs.

DESIGN FOR A TEAPOT COFFEE POT, OR SIMILAR ARTICLE—M WEINTRAUB New York N Y This ornamental design for a teapot coffee pot or similar article represents a teapot of harmonious proportions and highly elaborate ornamentation Scroll work profusely covers the entire article except the numerous scenes of pastoral and social life pictured around the lower part

DESIGN FOR A SWIMMING BAG.—A P RASMUSSEN New York, N Y The view of a swimming bag of ornamental design shows an article of square form at the lower half Half way up the sides the bag is shaped with two graceful inclines the top one on each side forming the bottom of a ring the form two of which constitute the top of the bag

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NOTE Copies of any of these patents will be furnished by the SCIENTIFIC AMERICAN for ten cents each Please state the name of the patentee title of the invention, and date of this paper

Notes and Queries.

Readily know your queries on separate sheets of paper when communicating about such matters as patents, subscriptions, books, etc. This will greatly facilitate answering your queries, as in many cases they have to be referred to experts. The full name and address should be given on every sheet. No attention will be paid to unsigned queries. Full names for correspondents are preferred from time to time and will be mailed on request.

(12556) J F S asks. *B* is a brass cylinder 2 inches diameter and 12 inches long. *A* is a plunger, weighing ¾ pound. *D* is a ½ inch pipe connected at bottom of cylinder *B* leading to tank 4 inches above top of cylinder. Why won't plunger *C* lift water or force it rather into box as the plunger is much heavier than the water it has to raise? What size pipe will it require, as I cannot increase weight of plunger? A. The true height of lift in your sketch is not 4 inches, but the total height from base of plunger when it rests on water to level of bend in pipe. A ¾ pound plunger in a cylinder of 3.14 inches area (equal to 2 inches diameter) will

balance a head equal to ¾ ÷ 3.14 pounds or 0.24 pound per square inch nearly, equivalent to 6.6 inches of water (since 12 inches head of water is 0.434 pound per square inch pressure). From your sketch we judge your plunger is about 6 inches long, and that the head of water is therefore about 6.6 inches at the height to which it is shown as rising while you would have to add ½ pound more weight to the plunger to lift it to the tank (disregarding friction). You can reduce the diameter of cylinder and plunger to 1.6 inches nearly, and the head will then just balance the ¾ pound plunger.

(12556) J M K asks. 1 How much loss of power would result in transforming say 10 volts, 10 amperes, direct current into 20 volts 5 amperes? Have you got a SUPPLEMENT describing such a transformer, and the making of same? A A large loss would take place in changing 10 amperes at 10 volts direct current to 20 volts and 5 amperes changed to 5 amperes at 20 volts. There is no transformer for a direct current excepting some form of an induction coil which will need an interrupted current. It would not be cheaper and simpler to double the battery and so get your 20 volts and 5 amperes by a suitable resistance. 2 Have you got a SUPPLEMENT describing a small voltmeter? Also a small ammeter. A You will find a volt meter and ammeter described in our SUPPLEMENTS 1215, price ten cents. They are of simple construction and can be made by an amateur. 3 Have heard that the Mississippi River flows up hill, being driven onward by the centrifugal force of the earth? A The expression that the Mississippi River flows up hill because of centrifugal force is not a correct expression. Water cannot flow up hill. A water level is the surface of still water anywhere on the earth. The ocean is level, but at the equator the water and the land surface are thirteen miles farther from the center of the earth than at the poles. The Mississippi River at its source is above the level of its mouth, and the water flows down to its mouth from its source. Centrifugal force lifts the water level thirteen miles at the equator above its position at the poles. A ship does not sail up hill from New York to the equator. It goes over a water level and neither up nor down.

(12557) J M says: Kindly let me know whether the wheels of an automobile on the inside or outside of a curve leave the ground when going at a fair speed around said curve, and why? A The inner wheels of a vehicle leave the ground first when it overturns in rounding a corner too rapidly. Centrifugal force acts outward upon the vehicle through its center of gravity, which is above the ground. The following is on the ground through the rim of the wheels. This forces the vehicle to turn over upon the outer wheels. The outer rail of a track is raised to prevent the same effect in railroad trains. The outside of a race track is banked for the same purpose in bicycle races. The riders lean in very far in rounding the curves to prevent being thrown outward.

NEW BOOKS, ETC.

A SHORTER COURSE IN WOODWORKING. A Practical Manual for Home and School. By Charles G. Wheeler. New York: G. P. Putnam's Sons. 1911. 8vo.; 386 pp., 765 illustrations.

Manual training is so recent an addition to the general curriculum that its exponents are apt to be either professional teachers whose knowledge of the subject, as regards practical or skilled mechanics whose ideas of teaching are somewhat crude. This "Shorter Course" is intended to help both classes, and the independent student as well. Its first division, "Common Tools and Their Uses," is very exhaustive and clear, being so profusely illustrated that the figures are often some pages in advance of the text which refers to them. The second part "Operations in Shaping, Fitting, and Finishing," tells how to miter, dowel, splice, cleat, chamfer, and groove. This division also gives instructions for moldings, for panel and door making, and for the elementary operations in simple carved work. An appendix deals with such primary principles of construction as are embodied in gates, simple bridges, and roofs; and with practical problems in drawing and in laying out work. In every way the manual excellently fulfills the purposes with which it set out, and is a worthy follower of the same author's "Wood-Working for Beginners."

GARAGES, COUNTRY AND SUBURBAN. New York: The American Architect, 1911. 410., 80 illustrations.

He must be hard to please whose eye is not gratified by the garages shown in the beautiful half-tone reproductions of this album. Even Cairo, Egypt, has yielded the publishers an artistic and satisfying model, while America has apparently been ransacked for buildings that delight the artistic sense and meet the most exacting practical requirements. The plans of most of these are included, so that much help is afforded the man who is deciding on the structural features of a new garage. Some twenty preliminary pages of text take under consideration the essentials of construction and equipment, including the safe handling and storage of oils.

THE LANDSCAPE GARDENING BOOK. By Grace Tabor. Philadelphia: The John C. Winston Company, 1911. 8vo., 180 pp., illustrated. Price, $2 net.

Gardens do not happen, declares Miss Tabor. A perfectly satisfying garden is the outgrowth of artistic sense, careful planning and accurate execution. In the large plans of her attractive volume are presented not only perfect vistas but also scenes which fall just short of the effect aimed at, by reason of some too insistent feature or some subtle lack. Without dwelling at great length on the cultural side of the matter Miss Tabor treats of the gardens of suburban home of moderate size in relation to its setting giving the laws that govern the arrangement of gardens, trees, shrubs and flowers as affected by the site and the house itself. In a word she talks about color in the whole difficult problem of making a house seem at home in its site. The utilization of natural features, the approaches, the blending of architecture and nature, making the most of views, the garden furniture and accessories—all these phases of the subject are capably handled. The illustrations are fine half-tone plates of representative gardens and houses interspersed with practical diagrams and planting plans.

THE ICE AGE IN NORTH AMERICA And Its Bearings upon the Antiquity of Man. By G. Frederick Wright, D.D., LL.D., F.G.S.A. Oberlin, Ohio: Bibliotheca Sacra Company, 1911. 8vo., 763 pp., illustrated. Price, $5.25.

The first edition of this work was published twenty years ago but the interesting manner in which it is written, combined with the width and accuracy of its observations and the value of its deductions, made it a popular and standard book. Much material has been added to include the later discoveries, together with fifty new maps and illustrations. There are several chapters on glaciers other than those of North America and the first part of the volume comprises an exhaustive study of ice and its action. The second part discusses the time during which the ice sheet existed, and the have upon man's antiquity. As the author of "Scientific Confirmations of Old Testament History," Dr. Wright naturally leans toward an interpretation of Nature which conforms to Biblical statement, and it is his contention that recent discoveries have in no wise falsified his original reasoning and theories, but that, on the contrary they show the date of the last glacial epoch to be more recent than that it is usually represented to be. There is a bibliography covering no less than thirty pages.

THE HOUSE FLY Disease Carrier An Account of its Dangerous Activities and of the Means of Destroying It. By L. O. Howard, Ph.D. New York: Frederick A. Stokes Company, 1911. 8vo.; 312 pp., illustrated. Price, $1.50 net.

Here is a timely work on a subject intimately touching the public health and welfare. The recent increased agitation against house flies and the danger they represent is proved to be a sane warning against a very real menace. The author gives a life history of the fly and, assisted by well-executed plates that show its organism and habits, cites exact experiments in proof of its activities as a disease carrier. The array of evidence is conclusive, and most interestingly presented. The reader is then enlightened as to remedies and preventive measures. These include the prevention of breeding by treatment of all places in which breeding is possible, keeping flies out of the house, and killing them as they enter. Some ten millions of dollars are expended each year in the United States alone in an attempt to screen dwellings against the entrance of flies and mosquitoes. Another not inconsiderable item of expense is incurred in trapping and killing the pests after an entrance has been effected. With a little harmonious action on the part of individuals, Boards of Health, and communities, the breeding places might be rendered harmless and these expenses avoided. Until this comes about, however, housewives may read in the latter part of the volume of almost every device ever thought of for disposing of the mature fly. As Chief of the United States Bureau of Entomology, Mr. Howard's utterances should carry authority and inspire confidence.

WESTERHAM WITH ITS SURROUNDINGS. A Handbook to Wolfe-Land. By Gibson Thompson. New York: Frederick Warne & Co. 112 pp.; illustrated.

The quiet little Kentish village of Westerham is the birthplace of General Wolfe. Although so near London, the surrounding district is intersected by rambling paths that give glimpses of some enchanting views. The village itself is little altered since the days of Wolfe. The philology of the name carries us back to centuries in the Domesday Book of William the Conqueror it appears as "Oistreham." The handbook—one of the famous "Homeland" series—while serving as a brief history and general guide to the district, lays much stress upon Wolfe's connection with Westerham, sketches his boyhood and manhood, and presents pictures of the vicarage in which he was born and of the buildings and byways so familiar to him.

PRELIMINARY REPORT ON A VISIT TO THE NAVAHO NATIONAL MONUMENT, ARIZONA. By Jesse Walter Fewkes. Washington: Government Printing Office, 1911. 8vo.; 35 pp., illustrated.

This Bulletin 50 of the Bureau of American Ethnology, is a most instructive monograph on the important prehistoric ruins reserved under the name Navaho National Monument. These ruins are connected with Hopi pueblos still in hand, in which are preserved traditions relating to them and their ancient inhabitants. The Preliminary Report will be followed later by a more detailed account based upon a thorough and extended examination. In the meantime we have here much material for study and some admirable photographic reproductions of the major and minor treasures already revealed. There are maps of the groupings and sketches showing the detail of construction, with a map showing the surrounding country and indicating the location of the various objects of interest.

ADVENTURES IN HOME-MAKING. By Robert and Elizabeth Shackleton. New York: John Lane & Co., 1911. 12mo., 360 pp. Price, $1.75, postage, 10 cents extra.

There is always a demand for a book which deals with the transformation of an old house into a modern dwelling. The potentialities which exist in old houses, especially old colonial houses, is very great, and the authors of this book have performed a difficult task in an admirable manner. The finding of the house is discussed; this is followed by the planning, which begins with the library, then the fireplace and the secret stair are taken up; then the old parlors are dwelt upon, and this is followed by a description of the whitepanelled dining room, the halls, the bed rooms, the guest room, and then we are taken to the outside, where a formal garden, the lawn, the shrubs, the trees, the spring house, and the stone walled pool are all discussed. The illustrations, which are inserted apart, are excellent. There is little question but that the book will be warmly received.

THE MANUAL OF STATISTICS Stock Exchange Hand-Book 1911. New York: The Manual of Statistics Company. 8vo., 1092 pp. Price, $5.

It is hardly necessary to commend the thirty-third annual issue of this hand-book to those who are familiar with earlier editions. For the benefit of such investors as may not have seen the work we may say that it is a compilation of information about railroad, industrial, and government enterprises including all those of the United States, Canada, and Mexico whose securities are listed in the leading stock markets. Following the style of each corporation is the date of its formation and a brief history of its life to date, with a statement of its stock authorized and issued, its holdings, its bonded debt, and its floating debt. In the case of railroads even freight traffic statistics are given, and in all cases much detail as to dividends, surplus, and depreciation is added. Other features of the manual are tables of securities showing the high and low quotations of the past three years, and statistics on mining, cotton, produce, money, and banks. This reference book should be upon the desk of every investor, broker, and man of business.

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e Aeroplane in Naval Service

(Concluded from page 394)

deck of this boat and returns to it. rises obliquely or in spirals above its ating nest, and having reached a varia- e height, according to the lucidity of e atmosphere, it can, on a clear day, iscover the presence of the enemy on horizon a hundred miles in diameter, while itself remaining invisible and unassailable. Then it can redescend upon its ship and, by means of wireless telegraphy, send the results of its observation to the friendly fleet a couple of hundred miles in the rear. Thus, ten hours before coming in contact with the enemy, the commanding admiral would know of the presence, the strength, and the position of his opponent, and would be able to evade or attack, to join another division of the fleet, or to commence a flanking movement, etc.

At present we make use of wireless telegraphy alone. One or several scouts are sent ahead of the squadron. When they discover the enemy they are at close quarters, and even so they have a pretty poor view, they see from below, with a visual ray which grazes the sea and loses the relief, and at the same time it is necessary that they inform the commander-in-chief as soon as possible, the wireless is set to work, but it speaks without having seen or having seen but imperfectly. The aeroplane, on the contrary, takes its survey overhead, undisturbed, and out of harm's way It is the indispensable auxiliary of the wireless; it is the eye of the scout, as the radio-telegraph is his mouthpiece, the two elements complement each other, they are inseparable.

But I insist on this point, that for its present use, as yet the aeroplane of the high seas be considered only as a "giant aerial periscope"; i. e., it must not go far from its point of support, it must not get out of sight of it, so that if any vexatious motor troubles occur, the convoy may immediately hasten to the succor of the poor shipwrecked bird

For our flying machine is not yet acclimated to extended maritime excursions, and over sea as over land the stoppage of the motor may happen suddenly On land this accident is of minor importance; a landing is made with more or less difficulty, but the landing is made; the injury is repaired, and you depart once more

But at sea the aeroplane which descends to the water because of motor trouble, even if provided with floats, is very probably not in a position to be repaired by the pilot The aviator cannot leave his seat to change a spark plug or mend a feed-pipe. He cannot get off again by himself, at least with the present motors.*

We have to-day flying machines, which fly as well over water as over land, if not better Let us make use of them at once, such as they are, that is the most urgent point, and afterward we can apply ourselves to the long and arduous task of making them veritable sea birds, with untiring wings, masters of wind and wave.

And so this end what is necessary? No great thing to begin with, and above all not many operators'—a few aviators with sufficient knowledge of the technique of aviation, a few carpenters and mechanicians, a much greater number of machines, naturally, than there are pilots, a repair shop, and a judiciously chosen aviation field on the seacoast in a favorable climate. Then, on the sea, a specially equipped cruiser, two torpedo boats, or better, two motor-boat scouts, and a tug.

Maritime aviation exists already in latent fashion; to co-ordinate its elements and to know how to set them in motion would be sufficient to endow the marine with this new service which might be to it of so much assistance.

* This can now be accomplished, thanks to a device recently on the "Comet" of Voisin, by which the pilot himself can start the motor without leaving his seat.—Ed.

Indoor Lighting, Natural and Artificial

(Concluded from page 393)

that no light shall fall directly downward, and its glass sides shall be at such an angle as to deflect the entering light as much as possible away from the vertical and all of the glass surfaces should be of a quality of glass that will cause a diffusion of the light

To make it impossible for the sun's rays to fall directly on the floor, and to direct the light toward the walls, the superstructure must have the form of a large prism, the top being entirely opaque and the sides sloping at an angle of 30 degrees. With this construction the light is admitted only through the sloping sides, it is partially diffused and its principal forces is directed toward the gallery walls The under skylight or ceiling glass gives a further diffusion and if the quality is correctly selected, it will thus practically obscure the source of light from the observer's eye and if the color of the floor is made darker than that of the walls, the result is very satisfactory and the true requirements are met without the introduction of a canopy or other objectionable screen, at least so far as daylight lighting is concerned

The artificial illumination equipment must necessarily be of a design that gives full consideration to the fundamental principles observed in connection with daylight lighting

Owing to our ability to direct and regulate the force of the light more readily under artificial conditions, we can, with this form produce results even more perfect with respect to diffusion and uniform wall intensity, than are possible under daylight illumination; and though perhaps not exactly reproduced, the quality and color of the daylight can be approximated closely

For many reasons the electric lamp is the most suitable for interior lighting A type, however, must be selected that will give a steady light and the electric wiring must be so planned as not to interfere with this condition As in the case of the power of a water fall, the energy of light, if under control and suitably applied, will accomplish much, but if incorrectly used, its efforts may do more harm than good

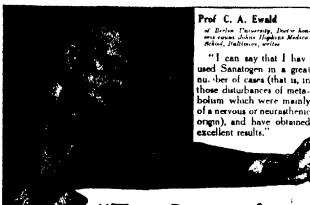
Fig 3 is an illustration of this latter condition, from which it will be seen that two brilliant electric lamps have been placed between the observer's eye and the objects which it was intended should be lighted

Another mistake frequently made in lighting pictures, or other similar exhibits, is to use an electric lamp in a trough reflector, the whole device being placed in front of one or more pictures the idea being that a strong light is thus cast, and the source of light is screened from the observer's eye, all of which is true, but the effect is a very "spotted" picture. The best results from artificial lighting will be obtained when the light sources are entirely outside of the room in which the exhibits are displayed

Figs. 1 and 2 illustrate galleries of equal size where the artificial lighting has been so arranged and where the prism-shaped superstructure has been used to provide the best natural lighting The photograph from which Fig. 2 is reproduced was taken by daylight only with a three-minute exposure, and it is clear from the reproduction that the principles governing the best interior lighting have been well carried out in this installation

The prism superstructure also serves another excellent purpose, for it provides a housing in which the simplest, but most effective artificial lighting equipment can be arranged Within this space, specially constructed electric fixtures should be hung, the lamps being supported in rows, and at a uniform distance from the under glass The fixtures themselves will thus be entirely screened, as the glass, when properly selected, will diffuse the entering light and practically nothing can be distinguished through this glass from below. The fixtures themselves being entirely screened can be made of the simplest pipe construction, thus involving a minimum of cost.

By placing a concentrating type of opaque mirror reflector just back of each of the incandescent lamps and adjusting these lighting units at a pre-determined angle, numerous beams of light will be thrown directly on the walls of the room below, and by properly calculating the location of the lamps and their number, and by giving the inner surface of the mirror reflector a double angle, thus making its sectional form approach the



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line of the true parabola, we will obtain the greatest benefit from each unit of illumination provided.

The photograph from which Fig. 1 is reproduced was taken entirely by the artificial light provided by an overhead electric lighting equipment of this kind, and it is interesting to note that while the exposure in this instance was the same as that of Fig. 2 (three minutes) the diffusion of the light, in the case of Fig. 1 is superior to that obtained from Nature's lighting and the relative intensities of illumination of the interior surfaces of the room in Fig. 1 more nearly accord with perfect conditions, the intensity on the wall surface being almost exactly uniform throughout.

This latter result is accomplished in a very interesting way, for as stated before, the force of the light from the incandescent lamps is thrown directly on the walls, but the beams of light are so adjusted that the fringe of one overlaps that of the next all of which in turn are diffused as they pass through the ceiling glass. An observer standing underneath the ceiling glass, looking upward, can scarcely detect the position of the sources of the light, so nearly are they screened by the underside of the opaque reflectors.

A comparison of Figs. 1, 2, and 3 brings out clearly the importance of eliminating the source of light from the field of vision and the need for a uniform intensity of illumination on the wall surfaces also, the fact that artificial illuminating equipment can be planned for interior lighting that will produce results very closely approximating the best to be had under natural lighting conditions. This application of illumination might suitably be termed directed-indirect lighting and its field is almost unlimited for interior use.

A Landsman's Log Aboard the Battleship "North Dakota"—II

(Continued from page 891)

Phillip, whose "Don't cheer, boys, the poor fellows are dying" as it rang down from the bridge when the "Texas" drew up to one of the sunken Spanish cruisers after the Santiago fight, was one of the finest expressions of the spirit of the navy that ever became a classic. Times have changed since then, and people too. Certainly the navy has changed, and in nothing so greatly as in its gunnery. I crawled around the ship looking for broken metal, whose white fractures would show that they were recent and had been made by the "Delaware" in that day's firing. There they were—holes near the channel plate, where the shots had entered, and right holes near the water line on the lee side of the ship, where they had left it. There must have been others—I had no time to look for them. Indeed, I was perfectly satisfied to find this much evidence that projectiles fired at these unprecedented ranges had struck the diminutive mark afforded by this little ship. Whose starboard lee sunken condition was not more than ten or twelve feet. The "Delaware," in hitting the "San Marcos" at eight to ten mile ranges, had done incomparably finer shooting than the whole fleet at Santiago, which made less than four per cent at a two-mile range.

Then it was "all aboard" for the "Delaware," and after another four or five miles of nautical gymnastics (the behavior of these steam cutters in the lumpy seas of the Chesapeake and on the southern drill grounds was something that must be seen and felt to be understood—our particular boat did everything on that trip but stand on its head and sit up on its stern), we boarded the "Delaware," to hear its gunnery officers and everybody else connected with the ship bewailing the fact, forsooth, that they had not done better shooting! To me the work, in view of the great range, had seemed to be truly wonderful. As I was merely a landsman, however, I had to be content to believe that they considered their shooting to have been indifferent, and that by giving more time between salvos for the spotter's directions to be plotted and sent to the gun stations, they could have greatly bettered the performance.

It is this setting of an exceedingly high standard—this determination to be satisfied with nothing short of the best possible results—that enables our ships to shoot accurately and swiftly at ranges that are not attempted in any other navy in the world. "The first salvo that lands will practically win the fight," is a statement that I heard frequently repeated during that two weeks' cruise with the Atlantic fleet, and I saw enough, that day, to satisfy me that, as matters stand, our ships would drop their shells upon an enemy long before he could hope to make any effective reply.

(To be Continued.)

The Current Supplement

THE front page of our current SUPPLEMENT, No 1869, shows a fine illustration of a rather remarkable bucket chain excavator at work in a Hungarian cement pit.—A peculiar amalgam which appears to consist of a mixture of mercury with the radicle ammonium, has been known since the days of Berzelius. Its true character has long been a matter of dispute, and is of interest as furnishing an apparent example of a compound radicle possessing true metallic properties. The subject of such synthetic metals is discussed by Prof McCoy.—An article reproduced from *Nature* deals with the hydro-electric plants of Norway and their application to electro-chemistry.—A catalytic process for effecting the direct union of hydrogen and nitrogen to ammonia has been worked up by Prof Haber. An account of this important development has been given by J. A. McDermott.—We have all of us at one time or another twanged the spokes of our bicycle to determine whether they were in proper condition. A similar but more elaborate test is now applied to the wires of aeroplanes, according to an invention of Capt F. Largier, which is described and illustrated in this current issue.—A most interesting review of recent developments of astronomy is given by J. S. Plaskett.—An illustrated article deals with the varied uses of the royal palm, one of the most striking vegetable features of Cuba.—The fruit industry in the West has grown to gigantic dimensions. A single frost may cause vast losses. Prof. McAdie has published somewhat extensively on the subject of frost protection in fruit orchards. Some of his work, illustrated with photographs furnished by him, is reported in a brief article.—The article on caisson sickness is brought to its conclusion in a second installment.—Those interested in locomotive engineering will find valuable information in an article on a new fourteen-wheel express locomotive.—A high speed cast-iron flywheel of remarkable design is described and illustrated in an article derived from *Power*.—The versatile genius of Swedenborg led him, among other things, to evolve some plans for a flying machine. This historical curiosity is reproduced from a publication of the Swedenborgian Association.

Death of Eugene Ely

FLYING at the State Fair Grounds, Macon Georgia, on the 19th of this month, Eugene Ely, in a Curtiss biplane, lost control of his machine and dashed to earth. As the machine neared the ground, Ely attempted to leap clear of the machinery, in this he was partially successful, but the impact was sufficient to crush him so badly that he died shortly afterward. Eugene Ely joined Glenn H. Curtiss in the summer of 1910. Last November he sprang into fame when he launched his aeroplane from the U. S. S. "Birmingham," and flew to shore, eight miles away. In January he reversed this feat by flying from shore to the armored cruiser "Pennsylvania," landing on a special platform built on the deck of the vessel. He was with the army aviation corps at San Antonio, Texas, where his work at scouting was notable.

The Development of Spitzbergen

PRESS reports from Copenhagen state that the total export of coal from Spitzbergen this year will amount to 2½ large cargoes, and it is expected that fully 100 will be exported next year. The political status of Spitzbergen is still undetermined, but it has been fully surveyed by the Norwegian government, which is also about to open a wireless station there, and it is evident that Norway will do its utmost to establish sovereignty over this far northern country. It is stated that the Norwegians have discovered new mineral deposits, the situation of which is kept secret.

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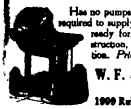
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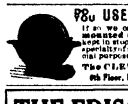
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A Correction

To the Editor of SCIENTIFIC AMERICAN.

In my article on the Diesel engine, on page 314, next to the last paragraph, the statement is made "On the other hand, in an engine with eight cylinders, one cylinder may not become inoperative without affecting the power of the engine to a very great extent." The word *not* in this sentence is an error, as the point to be made was that an engine having as many cylinders might run with one cylinder inoperative without affecting the power, to any serious extent.

HAYNER H. GORDON.

October 7th, 1911.

Roots in Sewer Pipes

To the Editor of SCIENTIFIC AMERICAN.

I noted with interest to-day the illustration and article on page 281 of the SCIENTIFIC AMERICAN, referring to roots in sewer pipes, and a shield to prevent their entrance. In passing, I should like to remark that so far as my experience goes, sewer pipes are cemented together, a "baby" or pad of cloth or burlap being dragged through by the mason to smooth the interior of the joints.

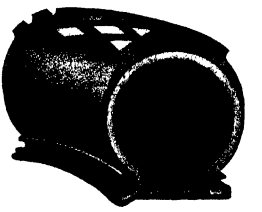
Returning to the roots, I wish to say that while quartermaster at Fort Assininiboine, Montana, I found a main sewer pipe clogged, and a basement flooded with sewage one day. Upon digging up the pipe (it was about 10 feet down) it was found that a mass of fine, hair-like roots bunched together, completely closed it. This pipe was 8 inches in diameter, but just at this point was a junction below which the main was 10 inches in diameter, and this, too, was found almost entirely closed by root masses. In all, 36 feet of pipe (about equal portions of each size) were replaced as the roots could be cleared out only by breaking up the pipe and pulling the masses of fibers out. The largest mass was about 6 feet long and 3 inches in diameter, and when washed out and dried was very similar in appearance to a bunch of oakum. The pipe was of the best quality of glazed tile obtainable and the joints were tightly cemented; but these root-fibers had grown through the pipe at all points, and so thickly that fragments of the pipe in some cases seemed to support a thick growth of hair. The roots came, apparently, from some small cottonwoods planted as shade trees along the road way, and the nearest were about 20 feet laterally from the pipe line. A friend of mine told me that he had had a similar trouble with eucalyptus roots in a California post, and had cured it by packing the pipes in salt. I therefore purchased all the coarse rock salt (not lump), but broken pieces) that could be obtained in the small neighboring town of Havre, Montana, and packed it about 3 inches thick below, on each side, and above the replaced pipe, completely inclosing it. In the dry soil of that country this mass of salt should not soon dissolve, and the earth immediately around the pipe would remain heavily "salted" for a long time to come. The cost was only a few cents per foot, and it is not easy to see how any roots could pass such a barrier.

Durham, N. H. G. W. EDGERLY.

A Curious Meteor

DR. MAX WOLF, director of the observatory of Heidelberg, reports in *L'Astronomie*, that on the night of May 22nd, he observed a faint meteor moving from east to west across the constellation Aquila. Its diameter was about 15 minutes of arc. It passed rapidly over the star Gamma Aquilæ, and disappeared, leaving behind it a faint trail which vanished almost immediately. The remarkable feature of the observation was that the star Gamma remained invisible for fully 3½ seconds after the meteor and its train had disappeared. The obvious explanation is that the meteor left behind it a trail of opaque and non-luminous matter, dense enough to eclipse the star

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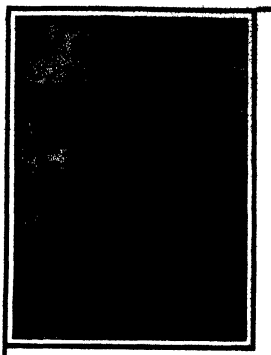
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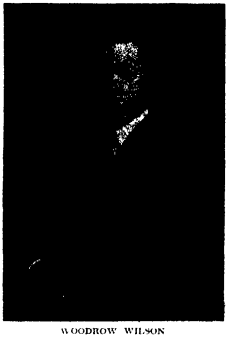
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A second article on **Cleveland's Administrations**, by JAMES FORD RHODES, deals with his attitude on the Silver Question and the Venezuela Boundary Dispute.

Two unusual stories: **John Flint, Deputy Chief**, by LAWRENCE PERRY—the story of a fireman. **A Mail-Order Cowboy**, by Lieut. HUGH JOHNSON.

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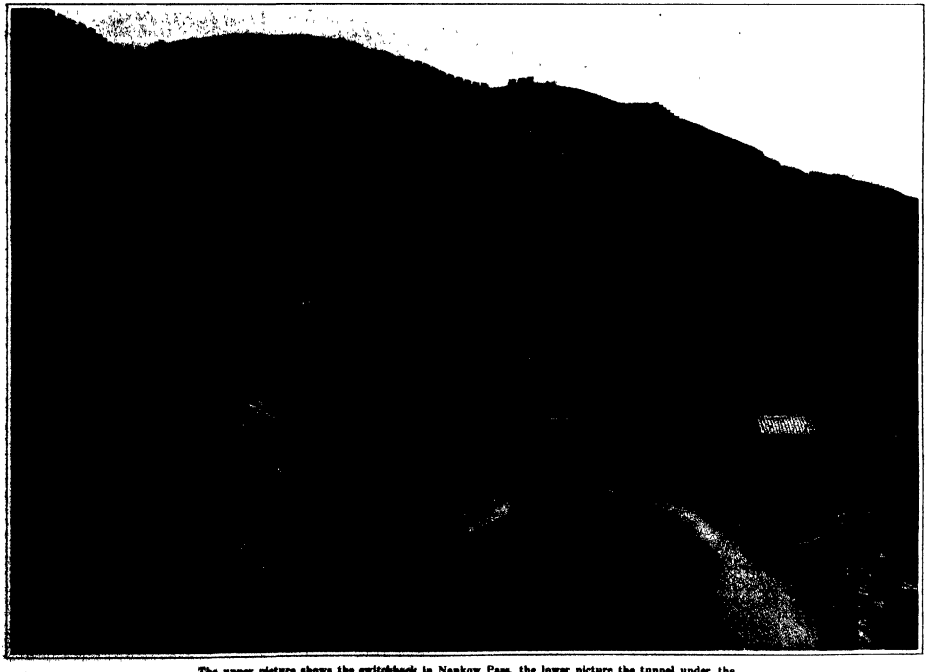
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The upper picture shows the switchback in Nankow Pass, the lower picture the tunnel under the great wall. The road was built by Chinese engineers and capital without foreign assistance.

THE PEKING-KALGAN RAILWAY. -[See page 409.]

SCIENTIFIC AMERICAN

Founded 1845

NEW YORK, SATURDAY, NOVEMBER 4, 1911

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Greatest Naval Review in American History

THE avowed policy of the Navy Department in gathering together the mighty fleet which is now assembled in the North River is to stimulate the interest of the taxpayers, by showing them, in one imposing object lesson, just what it is that the country has to show for the millions of money which have been expended during the past twenty years in building up a navy. We can conceive of no more effective way of doing this. Tabular comparisons and descriptive articles can do something in giving an adequate idea of naval strength—photographs of the ships will deepen the impression, but the only effective way to produce a sufficient conception of the number, size and power of the ships of a fleet is to line them up for a great naval review of the kind that is taking place this week in the fairway of the North River.

There have been some notable reviews during the era of our new navy, such, for instance, as that during the Columbus celebration, at the Jamestown Exposition, and in Long Island Sound, off Oyster Bay; but none of these compares in the number and power of the ships assembled with this great marine spectacle at New York. It is an interesting fact that, as far as the battleships are concerned, there will be found in line representatives of practically every type of American battleship that has been built during the past two decades.

Taking the ships in their historical order, we have first the "Indiana" and "Massachusetts," whose keels, together with that of the sister ship "Oregon," were laid in 1891. These ships, carrying four 18-inch and eight 8-inch guns on a displacement of a little over 10,000 tons, embodied a distinctive characteristic which has marked all American battleship design, namely, the exceptional weight and power of the battery. Recently reconstructed and furnished with the modern system of range-finding, with their gun mechanisms considerably modernized, these ships are still valuable for the second line of mobile defenses. The "Iowa," of 11,346 tons displacement, date 1897, was our first ship to carry the 12-inch gun. She mounts four 12-inch and ten 8-inch guns. The next class, "Kearsarge" and "Kentucky," 1898, is not represented in the review, nor are the three vessels of the "Alabama" class. The "Maine," however, is present, as representative of a class of three ships (date 1899), the other two being the "Missouri" and the "Ohio." In the "Maine" class as in the "Alabama" class of three ships which preceded, the 8-inch gun is missing, and a weaker battery of 6-inch guns is substituted. On a displacement of 12,500 tons the "Maine" carries four 12-inch and sixteen 6-inch guns.

Next in chronological order is the "Georgia" class, of which four ships, the "Georgia," "Nebraska," "New Jersey" and "Virginia," are present. It was around these ships that a fierce technical controversy raged, the bone of contention being the superposed turret, in which a pair of 8-inch guns is mounted above a pair of twelves, within a single double-deck turret. The "Georgia," 1901, is a vessel of 15,000 tons displacement and 19 25-knot speed. She mounts four 12-inch, eight 8 inch, and twelve 6-inch guns, a truly formidable battery, and it is but fair to state that, in spite of the limitations of the double-deck turret, certain of the heavy rifles so mounted have made some of the finest scores during target and battle practice.

The largest class among the battleships is that which is named after the flagship of Admiral Osterhaus, the "Connecticut." Six representatives of this design are present, the "Connecticut," "Louisiana," "Kansas," "Minnesota," "New Hampshire," and "Vermont." The keels of these ships were laid in 1903 and 1904. They displace 16,000 tons, and they all attained their trial speed of 18 knots, and generally exceeded it by from half to three-quarters of a knot. They carry an unusually heavy battery of four 12-, eight 8-, and twelve 7-inch guns, the last named being an armor-piercer up to considerable ranges. The completion of the "Connecticut" class marked the close of the pre-dreadnought period. The "Idaho" and "Mississippi," 13,000 tons, 17 knots, are small editions of the "Connecticut."

Of about the same displacement as the "Connecticut," but distinguished by the fact that they were the first all-big-gun ships to be built for our navy, are the "Michigan" and the "South Carolina," work upon which commenced in December, 1906. In the history of the dreadnought period these two ships will be distinguished as having been the first to introduce an arrangement of the big-gun battery, which was destined ultimately to be adopted in every navy of the world. The method may be described as "center line position and superposed firing," in which all guns are placed on the longitudinal axis of the ship, and the turrets are mounted in pairs, enabling the inboard turret to fire its guns above the roof of the turret farther outboard. Severely criticised at its first presentation, this system presented advantages so fundamental that it was bound ultimately to be accepted as the most effective compromise for securing broadside fire for every gun, and a sufficient concentration of end-on fire. The displacement of the "Michigan" and "South Carolina" is 16,000 tons. Their speed is over 18¾ knots, and they carry eight 45-caliber 12-inch guns in four turrets, and a torpedo defense battery of twenty-two, 50-caliber, 3-inch guns, which make up what they lose in weight and penetration by being carried in a lofty superstructure where they can be fought in any weather.

The first dreadnoughts, in size as well as gun power, to be built for our navy, are also moored in line. These are the "North Dakota" and the "Delaware," 1907. Our naval constructors were particularly happy in drawing the lines of these very fine ships. Visitors to the fleet will take note of the lofty forecastle deck with its pair of turrets carrying their guns 32 and 38 feet above the water line; and they will note also the long unobstructed sweep of the main deck, with its three turrets and six twelves. These two ships, with their larger sisters, the "Utah" and "Florida," are to our thinking, the handsomest battleships afloat to-day. On a displacement of 20,000 tons, they combine a speed of 21 knots with a battery of ten, 45-caliber, 12-inch and fourteen 5-inch guns, and the large bunker capacity of about 2,700 tons of coal. The "North Dakota" has the distinction of being the first turbine-driven battleship built for the United States Navy. The "Utah" and "Florida," 1909, fresh from the builders' hands, are the largest ships in the review. They embody certain valuable improvements over their predecessors. The displacement has been increased to 21,825 tons. Though the contract speed is a quarter of a knot less, on trial both ships made over 21 knots. They carry a battery of ten 12-inch, 45-caliber guns, and sixteen 5-inch.

The armored cruiser is represented by two fine vessels of the pre-dreadnought period, the "Washington" and "North Carolina," date, 1908 to 1905; displacement, 14,500 tons, speed 22¼ knots, and armament four 10-inch and sixteen 6-inch guns. These shapely vessels compare favorably with foreign armored cruisers of their time; but we could wish that the United States Navy included three or four dreadnought-cruisers of the "Inflexible" and "Von der Tann" type, whose speed and power may possibly prove to be the deciding factor in the next naval war.

Another interesting cruiser is the scout "Salem," one of three fast scouts, the "Birmingham," "Chester" and "Salem," of 3,750 tons displacement, and from 24 1/3 to 26 1/2 knots trial speed. In view of the fact that foreign navies have armored cruisers of greater speed and seaworthiness, opposing 12-inch guns to the 5-inch pieces of our scouts, it can be seen that they have been outbuilt and their field of usefulness must be extremely limited.

Very imposing is the fleet of twenty-two destroyers. Swift and sea-worthy, having the power and size to enable them to steam far and fast, even in heavy weather, these vessels must be considered as among the most efficient, both in themselves and in the way in which they are handled, of the unarmored craft of our navy. They range in size from 420 to 740 tons, and in speed from 28½ to 32½ knots. The largest of them are nearly 300 feet in length, and their full-load displacement reaches 900 tons.

Probably nothing in the review will excite more lively interest than the eight submarines, among which are included some of the latest and most successful of these craft. It is unfortunate that such an atmosphere of mystery and risk surrounds these vessels in the public mind. The maneuvers of the past year have shown them to be thoroughly seaworthy, absolutely under control, and possessed of powers of attack far beyond the common estimate of their abilities.

The weak point in the composition of our navy is its great deficiency in auxiliary ships, such as colliers and supply ships of the many and various kinds that are necessary to render the operations of a fleet effective. The eight auxiliary vessels present at the review are all converted merchant vessels, and to this extent they are necessarily makeshifts. Congress should make liberal appropriations both for supply ships and for large and speedy colliers, both types being designed specially for their several duties.

Urgently needed, also, is a large addition to our fleet of destroyers. The proportion of destroyers to battleships, as estimated by the leading naval powers, is four to one. Hence the battleships now in the North River should be accompanied by some one hundred of these craft. As a matter of fact, we have but thirty-six torpedo-boat destroyers in the whole navy.

Prizes for Military Aeroplanes

THE present war in Tripoli has greatly strengthened the interest displayed by the Italians in the possibilities of the aeroplane both as a means of reconnaissance and as a weapon of offense. Its value in the former capacity has been proven beyond a peradventure. In spite of the rapidity of its passage above fortifications and lines of troops, trained observers are able to obtain not only clear mental impressions of the details of arrangement, but they also have time to secure sketches and photographs, while their speed and the great altitudes at which they can fly render them practically invulnerable.

The recent maneuvers of the French aviation corps at Verdun were considered by military experts to have been brilliantly successful. Three aeroplanes, following two different routes, flew from the fortress at Verdun to the town of Tours, which was supposed to be in a state of siege. The machines covered 115 miles without descent, flying so high (from 3,000 to 5,000 feet) as to seem mere butterflies. Their observers noted every detail of the defensive works and the movements of troops, while they could easily have destroyed the captive balloon, which was the only measure of defense taken against them.

Besides its many apparent advantages, one authority mentions, also, that this means of scouting is more humane than older methods, since fewer scouts are needed, and their probable loss of life is far less.

As a weapon of offense, however, the aeroplane is still in a state of development, and there are divergences of opinion as to its ultimate effectiveness. Capt. Hildebrandt, the well-known German expert, is of the opinion that it can never take the place of the dirigible in destructive operations on a large scale. But the enormous comparative cost of the dirigible, with its greater vulnerability, and the difficulties of control when landing in boisterous weather, operate against its use, and give an impetus to the efforts being made to increase the offensive potentialities of the aeroplane.

An important step has lately been taken toward the furtherance of this aim. In a formal letter to the President of the Aero Club of France, a fund of 150,000 francs ($30,000) has been proffered by MM. Michelin to provide prizes for successful bomb-dropping from aeroplanes. The fund provides for four prizes. To win the first prize of 50,000 francs the aviator must carry five projectiles weighing 44 pounds each; must fly at a height of 650 feet or more; and must place his missiles, one by one, within a circle having a radius of only 32.8 feet. The prize will be awarded to the contestant placing the largest number of projectiles in the circle during a single flight. The second prize, of 25,000 francs, is to be won by the man who, flying at a minimum height of 3,280 feet, shall place the most projectiles within a rectangular area of 328 x 32.8 feet. The time limit for these two prizes expires August 15th, 1912. The limit for the remaining prizes is extended to August 15th, 1913, and the donors reserve the right to modify the conditions for these.

The results of the contests for the new Michelin prizes will be awaited with much interest especially since an American officer, Lieut. Riley W. Scott, has gone abroad with his bomb-dropping apparatus (described in our last issue), which is to be entered in competition.

The Heavens in November

Four Comets Now in Sight

By Henry Norris Russell, Ph.D.

IT IS a very unusual thing that two comets, conspicuous to the naked eye, should be in sight at once. Such was the case, however, during the early part of October, when Brooks's comet was still a prominent object in the evening sky, and could also be seen before dawn, while farther to the south, in the morning sky, appeared another comet, of about the same brightness.

This latter object, discovered by the Russian astronomer Beljawsky on September 28th, reminds one in some ways of the great comet of January, 1910. Both were first observed as conspicuous naked-eye objects, rising shortly before the sun, and in both cases it was some time before satisfactory observations of position could be obtained, owing to the difficulty of seeing the nearby stars (which serve as reference points) upon the brightly illuminated morning sky.

A satisfactory orbit has by this time been computed, which explains why the comet was not seen sooner. It was in perihelion, at a distance of 28 million miles from the sun, on October 10th. Three weeks earlier it was more than twice as far from the sun, and probably less than one-quarter as bright. Moreover, its orbit stands almost at right angles to the plane of the ecliptic, so that it came from far south of the sun, and remained south of him (and hence in a very unfavorable position for northern observers) until about the time of discovery. At the date of writing it is in the evening sky, in 15 hours R. A. and 3 degrees south of the equator and sets about 1½ hours later than the sun. On November 1st it will be almost due west of the sun, at a distance of some 25 degrees, and will still be observable; but, being already twice as far from the sun as at perihelion, and remoter, too, from the earth it will not be at all conspicuous, though it may be followed telescopically by southern observers for some time. Brooks's comet, which passed north of the sun on October 13th, at a distance of 36 degrees, is now a fine object in the morning sky. On November 1st it will be almost exactly on the celestial equator, not far from the star Gamma Virginis, and will rise fully two hours before the sun.

Its head, at last reports, was of the second magnitude, and its tail 20 degrees long; so that it will be well worth getting up to see, before the moon comes into the morning sky. Later in the month it recedes from us and from the sun, gets more and more nearly behind the latter, and disappears.

Still a third comet, discovered by Quenisset on September 23rd, is under observation. This one requires the aid of a field glass, at least, to make it visible. Its orbit is likewise highly inclined to that of the earth, but its distance from the sun at perihelion (on November 12th) is 72 million miles. At the beginning of November it is in 15 hours 45 minutes R. A. and 13 degrees north declination, and is moving south and a very little east, at the rate of 1 degree a day. This puts it 1½ hours west and 27 degrees north of the sun, so that it will be easily observable. It will probably be of about the seventh magnitude.

A faint periodic comet, first discovered by Borrelly in 1905, has been recovered on its return at certain southern observatories, but, being visible only in the most powerful telescopes, is of little interest to us.

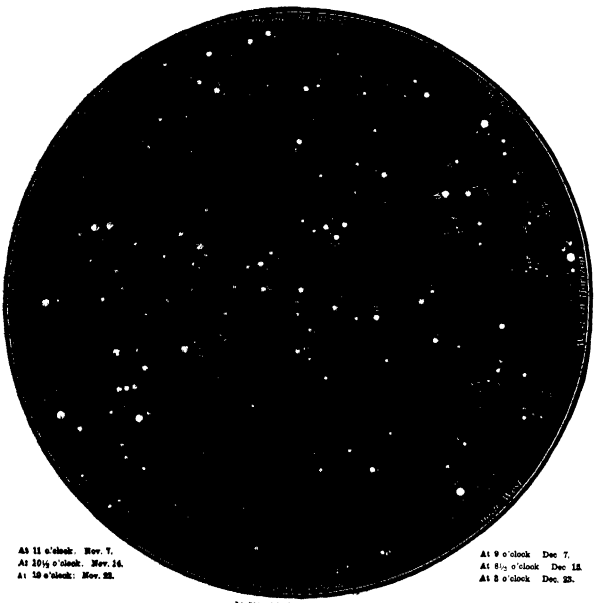
The Heavens

With the present month, a slight change is made in the manner in which the star-maps of our annual sequence are used. Up to this time they have shown the appearance of the sky during the early evening in the month of publication, or the later evening hours of the preceding month. There are some advantages in choosing our assumed hour of observation a little later, so that the same stars may still be seen, before twilight, during the month following that for which these articles are published. From this time, therefore, our map will show the sky as it appears at 10:30 P. M. in the middle of the month of publication, and at 8:30 in the middle of the next month.

At these hours, then, in November or December, the heavens will appear as the accompanying map shows them. The Great Bear is low in the northeast, and Draco and Ursa Minor are beneath the pole. Cassiopeia and Cepheus are high up, just west of north. The brilliant Vega is setting in the northwest, and the cross of Cygnus stands erect, just to the left. The great square of Pegasus is the most conspicuous object in the western sky. Below it lies Aquarius, the constellation represented in our initial letter. This is one of the ancient signs of the zodiac, but contains no bright stars. Its most prominent group is a small Y (lying on its side) formed by the stars ζ, γ, and two others. This represents the water jar from which the Water-Bearer pours forth a stream marked by small stars too faint to be shown on our map, which flows downward, first to the right and then to the left, till it is swallowed by the Southern Fish, whose one bright star, Fomalhaut, is now low on the southwestern horizon. Of telescopic objects in Aquarius, we may mention the star ζ Aquarii (the middle one of the Y) a fine slow binary pair, separated by 3.5 seconds, whose period of revolution is probably a couple of thousand years.

Due south is Cetus, with one conspicuous star, β, standing very much alone about 30 degrees northeast of Fomalhaut. North of this is the inconspicuous group of Pisces, and the small but brighter one of Aries, with Andromeda still higher, right overhead.

The most brilliant region of the whole heavens is now well up in the southeast, where Sirius has just risen. Orion is resplendent above him, and Taurus shines still higher up. Mars and Saturn, which are at present between Taurus and Aries, add their luster to the spectacle. Procyon is low down in the east, and Castor and Pollux are a little higher, and more to the north. Above them, the bright Capella marks the place of Auriga, and above this, almost overhead, is Perseus. Minima of the variable star Algol—may be observed at 8 P. M. on the 1st, 5 P. M. on the 4th, 10 P. M. on the 21st, 7 P. M. on the 24th, and so on, the eclipses coming on every third day, about 3 hours 10 minutes earlier by the clock.



NIGHT SKY: NOVEMBER AND DECEMBER

The Planets

Mercury is evening star throughout November, but being very far south of the Sun is ill placed for observation. Toward the end of the month he may perhaps be seen as he sets about 5 45 P. M.

Venus is morning star, at her very best rising in the neighborhood of 2 A. M. and getting high in the southeast before dawn. On the 16th she is in conjunction with the crescent Moon, and when nearest at about 2 P. M., will be less than a degree away. By this hour both will be low in the west, so, if we wish to see the planet in the daytime (which is perfectly easy if the sky is really clear) we will do better to go out in the forenoon, and look a couple of degrees east of the Moon.

Mars is in opposition on the 24th and is visible all night. He is farther from us than he was two years ago 47 millions miles but his high northern declination makes up for this, by carrying him high in the sky where we have to look through less of our own unsteady atmosphere in order to see him.

To find him, it is only necessary to look eastward and pick out the brightest and reddest thing in sight. With even a small telescope, he shows a considerable disk. The darker markings which are the most conspicuous features of the Martian surface can be seen fairly well with small telescopes, and these will also show that the "polar cap" is at present inconspicuous, most if not all of the polar snows having disappeared during the long summer of the Martian southern hemisphere, now near its close.

Jupiter is in conjunction with the Sun on the 17th, and is invisible throughout the month.

Saturn is just past opposition, in Aries, about 20 degrees west of Mars, and is finely placed for observation, with the ring-system opened widely. The contrast in color and brightness between the two planets is conspicuous to the naked eye.

Uranus is in Sagittarius, too low in the west at sunset to be well seen. Neptune is in Gemini, coming to meridian about 4 A. M. in the middle of the month.

The Moon is full at 11 A. M. on the 6th, in her last quarter at 2 A. M. on the 13th, new at 6 P. M. on the 20th, and in her last quarter at 9 P. M. on the 28th. She is nearest us on the 8th, and remotest on the 21th. She is in conjunction with Saturn on the 6th, Mars on the 7th, Neptune on the 11th, Venus on the 16th, Jupiter on the 20th, Mercury on the 22nd, and Uranus on the 25th.

Princeton University Observatory.

Photographic Scouting at Night

An Artist's Contribution to an Aeronautic Problem

WHILE the matter of using aeroplanes as actual fighting units in warfare is still in dispute, there is no question that they will play a most important part as scouts. In fact they have actually been used in this capacity by the Italian army in Tripoli. In the very earliest days of aeronautics this use of the aeroplane was suggested and pictures were published showing an army scout making sketches from an aeroplane. A later idea has been to use a camera so as to facilitate the work of the scout. It has occurred to the artist whose drawing is reproduced herewith, that photography under such circumstances would be rather difficult, owing to the fact that the machine would have to be brought within comparatively small elevation above the fortifications that were to be photographed, and would thus be an easy target for the gunners below. He believes that night photography would be better for then the aeroplane could steal into position over the fortifications, and flash its light upon them for a few brief moments while pictures were taken. The best camera for the purpose would be one adapted to take a kinematographic series of pictures. Out of the set of pictures thus taken, there would, he argues, surely be a few which would show the fortifications to good advantage as the aeroplane passed over them. The brief interval during which the searchlight of the aeroplane would play upon the fortifications might not be sufficient to enable the gunners to take accurate aim upon the aircraft. In order to increase the value of the photographs, it would be well to determine the height of the machine above the fortifications and hence the scale of the pictures. The height above sea level could readily be determined by means of a barometer, but it would not necessarily show the height above the fortifications. However, with a searchlight throwing a conical beam of fixed angle, the spot of light upon a film taken with a camera of known focus, would give an approximate index, from which the height of the machine above the fortifications would be determined. By this means it would be possible to make an accurate survey of the fortifications with a minimum exposure of the aeronauts.

Another method of discovering the height of the aeroplane above the fortifications, the artist suggests, is to have two searchlights placed at opposite ends of the machine and mounted to move together in such a way that their beams would intersect always at a fixed distance below the aeroplane. The height of the aeroplane above the fortifications would then be shown by the size of the intensely illuminated spot produced by the overlapping portions of the beams of light.



MAKING NIGHT PHOTOGRAPHS FROM AN AEROPLANE

The Recent Gliding Experiments of the Wrights

By Grover Cleveland Loening

A GREAT and widespread interest has been aroused by the experiments now being conducted by Orville Wright at the scene of the first great flights by man, Kitty Hawk, N. C. Many reports have been circulated with regard to the real purpose of these experiments, some of them no doubt exaggerated and perhaps amusing to the taciturn Dayton inventors. Orville Wright's "vacation" is nevertheless an occasion upon which the eyes of the aviation world have good cause to look sharply. Other than to teach Ogilvie how to glide, and to test a "tail" glider, Orville Wright is evidently bent upon continuing in a logical manner the exhaustive experiments in free flight conducted over so many years by his brother and himself.

The most startling achievements that have resulted from this latest series of tests are briefly as follows: In a biplane glider similar in many respects to the model B Wright machine frame, but differing in the smaller size of the planes and the use of a larger rudder, and sitting upright with the usual control mechanism in his hands, the aviator has succeeded in making glides that far exceed anything done in this line before. He has attained greater heights, greater distances, and stayed aloft a longer time. The general character of the glides, however, bears much resemblance to the 1903 experiments. On Monday, October 23rd, a curious accident took place. Rising some twenty feet from the side of the hill, the heavy rear rudder appeared to become uncontrollable and to make the glider so "tail heavy" that it began to turn over and start backward, whereupon Mr. Wright climbed to an upright position of safety on the overturning machine with such excellent judgment that when the apparatus struck the ground and smashed Mr. Wright emerged unhurt. This experience suggests that many of the fatal accidents in aviation were avoidable by the same *sang froid*.

Of course the lighter loading would make the time of fall in such an emergency, longer as well as render the shock lighter.

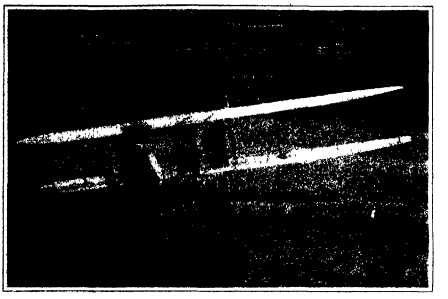
On the next day, October 24th, a feat that has long been predicted and looked forward to was accomplished. With consummate skill Orville Wright soared aloft into the teeth of a supposedly fifty-mile gale, and succeeded in not only soaring for a period of almost ten minutes but in actually advancing into the wind. This great flight was made over the side of the hill facing the wind so that the air currents must have had a decidedly upward trend. The distance covered by the flight was a quarter of a mile and the height attained estimated at 200 feet above the surface. Though the results are astonishing to many, those familiar with the nature of air currents expect even more startling performances at an altitude three or four times as great.

It is hardly possible as reported that the object of these tests was to try out a device for automatic stability. There is not yet enough known of wind cur-

tants and their motions to enable a thoroughly successful device of the sort to be even conceived. It may be definitely assumed that the purpose of Orville Wright's experiments are primarily to learn more of wind conditions. Many problems such as the avoiding of "side-slipping" still remain to be solved. Not until every possible vagary of the air currents becomes known, can a device for automatic stability be designed and be successful.

It is due partly to the peculiar phenomenon often called "Lilienthal's Tangential," that a glider with cambered planes can not only remain stationary but in a wind of great enough upward trend can be made to actually advance without the exertion of any motive power whatsoever. This would appear offhand like perpetual motion, but it must be borne in mind that the huge energy of the rising current itself is the source of power. The phenomenon referred to is merely, that at certain angles, the total air pressure acting on a plane ceases to act in a line normal to the plane or its chord and instead the line of action of this force takes a position well in front of the normal, the pressure thus materially acting in the dual role of a supporting *and propelling force*.

Octave Chanute, early in 1909, pointed out in a masterly way the manner in which this problem of soaring could be solved and many experts since then who have investigated the problem are convinced that it is a feasible one, even though it appears to defy physics. These experiments of the Wrights are therefore likely to bear fruitful results, results that may eventually become of the utmost importance. It will be interesting to note what changes in their standard design the Wrights will make as a result of these tests.



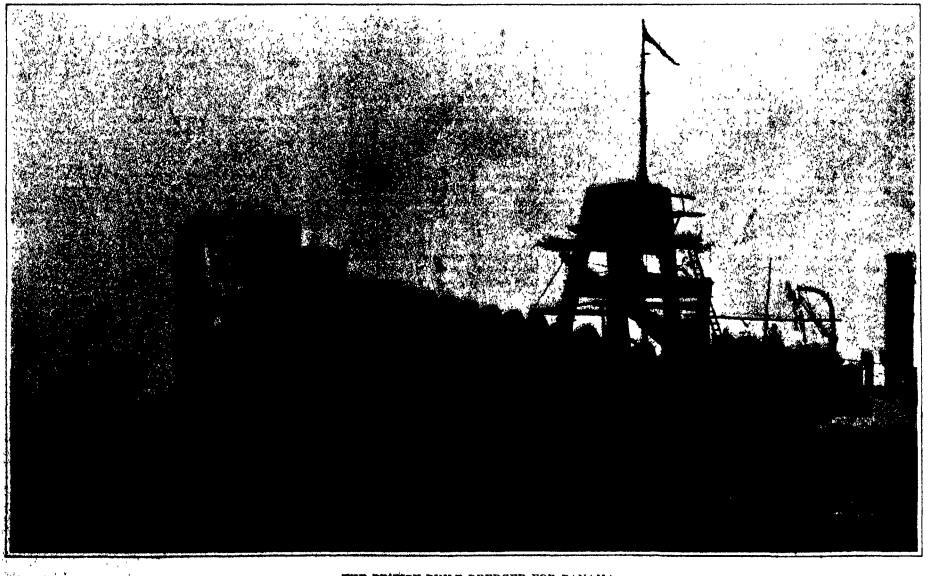
Orville Wright starting from the top of a sand dune with his new glider.

The British-built Dredger for Panama

Hopper Capacity 1,200 Tons of Dredging, Bucket Ladder will Reach to Depth of 50 Feet.

By Our English Correspondent

ONE of the vessels around which an acute political—we can scarcely call it economic—controversy has raged in America for some time is the "Corozal," an extremely powerful bucket dredger which has been built by Messrs. Wm. Simons & Company (Limited), of Renfrew, Scotland, to the order of the United States Government, for carrying out some of the most arduous underwater cutting to be done in connection with the Panama Canal. The vessel has a hopper capacity of 1,200 tons of dredgings and the bucket-ladder is designed for dredging up to a depth of 50 feet. It is propelled at a speed of 10 knots per hour by two sets of triple-expansion, surface-condensing engines, supplied with steam from two cylindrical, multitubular boilers, constructed to Lloyd's requirements for a working pressure of 180 pounds per square inch. A complete outfit of the most modern auxiliary machinery is provided in the engine room, including independent air pumps, circulating pumps, feed pumps, feed heater and filter, etc. The dredging gear is of the most massive description and is arranged to give three speeds of buckets to suit the various kinds of material to be dealt with. The dredging gear can be driven by either of the main propelling engines. Two sets of buckets are provided, one of 54 cubic feet capacity for dredging soft material and one of 35 cubic feet capacity for dredging stiff clay. The bucket ladder is a steel girder of exceptional strength and an idea of the great strength of the bucket chain may be conveyed by the statement that the ladder with its chain of buckets, links and pins, weighs upward of 240 tons. The upper end of the bucket ladder is supported on an independent pivot shaft and the lower end is controlled by powerful steel wire-rope tackle and independent steam hoist gear, which is designed for raising the latter at a speed of 10 feet per minute. Steam maneuvering winches are fitted at bow and stern, each driven by independent, two-cylinder engines and each barrel is fitted with friction clutch and brake to enable the mooring chains to work independently of each other, or simultaneously, as may be required. Shoots are provided for loading into the vessel's own hopper, also overboard shoots controlled by independent steam winches, for loading into barges alongside. The hopper doors are controlled by independent hydraulic gear. This dredger, "Corozal," was launched on the Clyde in September and she is to undergo severe tests before being despatched on her voyage round South America to the western end of the canal. Before leaving British waters, she will be tested, first in lifting sand and mud from the bottom of the Gareloch, off Helensburgh, and, afterward, she will be taken back to Renfrew where the buckets will be changed, and subsequently she will be sent to Belfast and tested in the hard clay of the Musgrave Channel. The dredger was constructed to Lloyd's full requirements and Mr. T. M. Post and Mr. A. V. B. Candlet have superintended the construction of the dredger on behalf of the United States Government for the Panama service.



THE BRITISH-BUILT DREDGER FOR PANAMA

Abstracts from Current Periodicals

Phases of Science as Other Editors See Them

Why is the Flesh of the Watermelon Red?

IN a recent number of the *Rundschau*, Prof O. N. Witt makes some very interesting reflections on the colors of living objects of nature We reproduce here in abridged form some of the essential points

Modern science teaches us that everything in nature has its definite purpose The naive point of view of past ages, according to which a well meaning Providence has adorned the world about us in order to minister to our pleasure, has had to give way to the inquisitive gaze of modern scientific investigation We now know that the refreshing green of the woods and meadows is not provided for our enjoyment, but for the serious and practical purpose of plant nutrition, the flowers display their bright colors to attract the insect that carries the pollen from stamen to stigma, the Alpine hare is snow colored so as to be hidden from the sight of his enemy, while the lion is tawny and the tiger striped, in order that he may be undistinguishable from the natural background as he lies in wait for his prey All these facts are plain enough and we admire the perfection of these adaptations, and this feeling of intelligent appreciation we now feel to be of greater worth than the ignorant worship of yore True it is that Darwin's brilliant hypothesis of the "survival of the fittest" does not satisfactorily explain just how the different organisms set about acquiring the various characteristics and colors which are now so useful to them. Here and there an instance may be found where the process of adaptation is explicable enough, but there are many cases which baffle the ingenuity of biologists of to-day What is still more unintelligible, and has apparently never been explained, is that nature is often lavish in dispensing brilliant colors where, in the natural course of events, they seemingly can never be of any account whatever The number of instances of this kind are innumerable, just a few may be picked out for illustration here Why, for instance, is the blood of all warm blooded, and of many cold blooded, animals, red? It is not intended, under normal circumstances, to be visible, its principal function being fulfilled in the lungs, hidden away from sight Attention has been drawn to the remarkable analogy between the red blood pigment and the green pigment of plant leaves, but whatever may be the chemical analogy, there is no analogy whatever in the functions, for the color of chlorophyl is plainly connected with its function in absorbing light for the purpose of building up starch from atmospheric carbon dioxide In the case of hemoglobin there is no such analogous function whatever Furthermore it is known that there must be colorless substances capable of performing the functions of the blood, for many animals of the lower type actually have colorless blood Again, we may ask, why is the flesh of many animals colored? For instance, why is the salmon colored with the hue which has taken its name from this fish? No one can tell

Exactly similar conditions are met with in the vegetable kingdom Why is the red beet deeply colored, while its close congeners have a white juice? After all, neither under normal circumstances, see the light of day, so that it is problematical what useful function the color can possibly serve Then again, why does the madder root contain quantities of alizarine and allied dye stuffs that in the past have been of such great value while in modern times we have learned to manufacture them by artificial means? Of what possible use can such dye stuffs be to the plants? Consider the watermelon, covered by a thick, opaque, dark green skin We may make some sort of conjecture as to the purpose of this, it perhaps serves in keeping off some of the large animals which would devour the fruit, skin and all, and thus leaving the melon to be burrowed by worms who leave the seeds untouched But why that appetizing pink color of the flesh of the melon? It cannot serve as a charm to attract visitors, for the guest that has eaten its way through the skin needs no further attraction, after he has reached the interior The black color of the seeds may perhaps be put down as a preventive measure protecting them from sharing the fate of the rest of the fruit

The attractive and appetizing outward appearance of most fruits is generally explained by supposing that its function is to attract animals, which eat the fleshy portion and carry the seed away from the parent plant, thus aiding the distribution of the species The red cheeks of a peach are so enticing that this explanation will probably be readily accepted But why that brilliant red color where the flesh meets the kernel? The bird that picks at the flesh of the fruit does not strike this colored layer until the work is practically accomplished.

Certain trees which furnish the so-called dye woods deposit pigment by the hundredweight within their stems. The woad or indigo plant and several others contain a substance known as indican, which is normally colorless but is transformed by a fermentation and oxidation process into deep blue indigo This case is particularly puzzling, since the color of the dye stuff is not even developed in the living plant.

Perhaps no science is more replete with problems for the future to solve than biology and physiology.

The Toughness of the Chinese Physique

IN a recent number of the *Popular Science Monthly*, Prof E A. Ross discusses some peculiar characteristics of the Chinese race in its resistance to disease. That there must be a marked difference in the character of this race as compared with ours is obvious enough, when we consider that out of ten children born among us, three, normally the weakest three, will fail to grow up; out of ten children born in China about eight are doomed to die in infancy. The difference is due to the hardships that infant life meets with among the Chinese, and it need hardly be pointed out that with such rigorous selection there will necessarily result a stock displaying a peculiar hardihood Just what kind of a hardihood depends on the particular conditions of selection, as Prof. Ross brings out clearly in his article. To anticipate his conclusion, the fact is that while the Chinese resist certain diseases with remarkable power, other diseases are more fatal to them than to us. Prof. Ross collected his data by questioning a number of physicians who had practiced for a number of years in China One or two among these gave an opinion differing from the others, but by far the great majority agreed in their verdict

Where the constitution of the Chinaman excels is in his extraordinary power to resist septic infection. Some of the instances cited to illustrate this fact are almost incredible and are too gruesome to invite repetition. Amazing, also, is their response to the treatment of neglected wounds

A boy whose severed fingers had been hastily stuck on any how and bound up with dirty rags came to the hospital after a week with a horrible hand and showing clear symptoms of lockjaw They washed his hand and sent him home to die. In three days he was about without a sign of lockjaw A man whose fingers had been crushed under a cart some days before came in with blood poisoning all up his arm and in the glands under the arm The trouble vanished under simple treatment A patient will be brought in with a high fever from a wound of several days' standing full of maggots, yet after the wound is cleaned the fever quickly subsides A woman who had undergone a serious operation for cancer of the breast suffered infection and had a fever of 106 degrees, during which her husband fed her with hard water chestnuts: Nevertheless, she recovered.

Living in the super-saturated, man-stifled land, profoundly ignorant of the principles of hygiene, the masses have developed an immunity to noxious microbes which excites the wonder and envy of the foreigner They are not affected by a mosquito bite that will raise a large lump on the lately-come foreigner They can use contaminated water from canals without incurring dysentery. There is very little typhoid, and what there is, is so attenuated it was long doubted to be typhoid. All physicians agree that among the Chinese smallpox is a mild disease. The chief of the army medical staff points out that during the autumn maneuvers the soldiers sleep on damp ground with a little straw under them without any ill effects. Coolies, after two hours of burden-bearing at a dog trot, will shovel themselves full of hot rice with scarcely any mastication, and hurry on for another two hours. A white man would have writhed with indigestion. The Chinese seem able to sleep in any position. I have seen them sleeping on piles of bricks, or stones, or poles, with a block or a brick for a pillow and with the hot sun shining full into the face. They stand a cramped position longer than we can and can keep on longer at monotonous toil unrelieved by change or break

But there is another side to the comparison. There is little pneumonia among the Chinese but they stand it no better than we do, some say not so well. There is much malarial fever and it goes hard with them. In Hong Kong they seem to succumb to the plague more readily than the foreigners Among children there is heavy mortality from measles and scarlet fever. In withstanding tuberculosis they have no advantage over us While they make wonderful recoveries from high fevers they are not enduring of long fevers. Some think this is because the flame of their vitality has been turned low by unsanitary living. They have a horror of fresh air and shut it out of the sleeping apartment, even on a warm night. In the mission schools, if the teachers insist on open windows in the dormitory, the pupils stifle under the covers lest the evil spirits flying about at night should get at them. The Chinese grant that hygiene may be all very well for these weakly foreigners, but see no use in it for themselves.

From the testimony it is safe to conclude that at least a part of the observed toughness of the Chinese is attributable to a special race vitality which they have acquired in the course of a longer and severer elimination of the less fit than our North-European ancestors ever experienced in their civilized state. Such selection has tended to foster not so much bodily strength or energy as recuperative power, resistance to infection and tolerance of unwholesome conditions of living. For many centuries the people of south and central China, crowded together in their villages or walled cities, have used water from contaminated canals or from the drainings of the rice fields, eaten of the scavenging pig or of vegetables stimulated by the contents of the cess-pool, huddled under low roofs, on dirt floors, in filthy lanes, and slept in fetid dens and stifling cubicles. Myriads succumb to the poisons generated by overcrowding and hardly a quarter of those born live to transmit their immunity to their children. The surviving fittest has been the type able to withstand foul air, stench, fatigue toxin, dampness, bad food and noxious germs. I have no doubt that if an American population of equal size lived in Amoy or Soochow as the Chinese there live, a quarter would be dead by the end of the first summer But the toughening takes place to the detriment of bodily growth and strength.

To the west the toughness of the Chinese physique may have a sinister military significance. Nobody fears lest in a stand-up fight Chinese troops could whip an equal number of well-conditioned white troops. But few battles are fought by men fresh from tent and mess In the course of a prolonged campaign involving irregular provisioning, bad drinking water, lying out, loss of sleep, exhausting marches, exposure, excitement and anxiety, it may be that the white soldiers would be worn down worse than the yellow soldiers In that case the hardier men with less of the martial spirit might in the closing grapple beat the better fighters with the less endurance

In view of what has been shown the competition of white laborers and yellow is not so simple a test of human worth as some may imagine. Under good conditions the white man can beat the yellow man in turning off work But under bad conditions the yellow man can best the white man, because he can better endure spoiled food, poor clothing, foul air, noise, heat, dirt, discomfort and microbes. Reilly's endeavor to exclude Ah San from his labor market is not the case of a man dreading to pit himself on equal terms against a better man. Indeed, it is not quite so simple and selfish and narrow-minded as all that. It is a case of a man fitted to get the most out of good conditions refusing to yield his place to a weaker man able to withstand bad conditions.

A Revival in the Whaling Industry

IT is reported in the *London Financial Times* that a Tyne firm is about to dispatch a fleet of five vessels—three whalers, a factory ship, and an oil carrier—to engage in whaling in the vicinity of Kerguelen Island, where Norwegian stations are already established. From many parts of the world comes the news of an active revival in the whaling industry, which had been at a low ebb for many years. Norwegian companies are said to be reaping enormous dividends in southwest African waters, and a German company, just formed with a capital of $250,000, is about to begin operations in the same region.

About twenty Norwegian expeditions, with crews aggregating 700 men, are in the field. The Norwegian companies, as a rule, buy second-hand British steamers, and fit them out with all the most modern appliances for whale catching and trying out. The whole process of recovering the marketable products from the carcass is carried on at sea.

Upward of a dozen whalers hail from Dundee. One of these, the "Balaena," has recently declared a dividend of 34½ per cent.

Engineering

Quick Work on Panama Locks.—Over sixty-seven per cent of the concrete for all the locks of the Panama Canal is in place. At Gatun 81.5 per cent of the concrete has been laid; at Pedro Miguel over 87 per cent; while the two twin locks at Mira Flores have about one-third of the concrete in place.

Tunnel and Terminus at Montreal.—A subsidiary company of the Canadian Northern Railway has completed plans for effecting an entrance into the heart of the city of Montreal by building a three-mile tunnel under Mount Royal. A new terminal will also be constructed, in which the latest improvements in terminal facilities will be embodied. The total cost of the tunnel and terminal together will be $25,000,000.

September Progress on the Panama Canal.—The total amount of excavation on the Panama Canal for September was 2,538,764 cubic yards, as compared with 2,687,088 cubic yards in September, 1910, and 2,836,365 cubic yards in September, 1909. The grand total of canal excavation to October 1st was 150,722,962 cubic yards. There yet remains to be excavated 44,599,417 cubic yards, which is less than one-fourth the entire excavation for the completed canal.

Evidence of a Mine Beneath the "Maine."—According to a dispatch from Washington, the former chief constructor of the navy, Rear-Admiral Washington L. Capps, who recently inspected the operations in uncovering the "Maine," will confirm the report of the Naval Court of Inquiry of 1898, which stated that the condition of the wreckage led to the conclusion that the primary explosion took place beneath the hull of the "Maine" in the neighborhood of Frame No. 18.

Cape Cod Canal Open in 1913.—In a recent address before the Atlantic Deep Waterways Convention in Richmond, Commodore J. W. Miller stated that the Cape Cod Canal will be open in 1913. This important work will enable shipping to avoid the stormy passage around Cape Cod and to pass from Buzzards Bay into Cape Cod Bay by a short connection of eight miles. The channel will be 30 feet deep at high water, which is more than the depth of the Manchester and the Kiel canals.

The Lathe as a Chip Producer.—Mr. Joseph Chilton, in a paper read before the North East Coast Institution of Engineers and Shipbuilders, states that as a chip producer, the lathe is the most economical of machine tools. He finds that a well-designed lathe, under favorable conditions, produces half a pound of chips per horse-power per minute when cutting mild steel, the pressure on the tool being approximately 100 tons per square inch "area of cut"—this last meaning the depth of cut multiplied by the feed; a cut half inch deep with a one-eighth-inch feed having an area of one-sixteenth of a square inch.

Great Steaming Radius of British Submarines.—The most notable fact in the development of submarines is their increase in size and in steaming radius. This means that the submarine is approaching the day when it will accompany the fleet on the high seas, and play a most important part in the general action of the future. The British are building two new classes of submarines, one of 600 tons, and the other of 800 to 1,000 tons displacement. Sixty-six of their latest submarines have a surface radius of 2,000 miles, which is being raised to 4,000 and 5,000 miles in what is known as the new "B" and "E" classes.

Deep Submersion of Submarines.—The submarine "Salmon" has established a record for deep diving, which exceeds anything that has been hitherto accomplished in our own navy. It will be remembered that during the early summer months, the "Octopus" attained a depth of 125 feet. This has been exceeded by 19 feet by the "Salmon," which was submerged to a depth of 144 feet off Prudence Island, and remained at that depth for 20 minutes. The submarine is certainly coming into its own, as will be shown in an article by Lieut. Bingham, Commander of the Third Submarine Division, which will be published in our Naval Number of December 9th, 1911.

German Naval Activity.—A recent government paper issued in Great Britain, giving the total naval expenditures for the last ten years proves how keen is the competition in naval construction among the great powers of the world. In 1901 Great Britain expended $50,000,000 on new construction, and in 1911 the amount is $85,000,000. Germany, which in 1901 spent $33,000,000, in 1911 is spending $58,000,000 on new construction. The United States spent $26,000,000 in 1905 on new construction, and she is spending about the same amount this year. The outlay for new construction in France was about the same in both years as that of the United States. The most significant feature of this comparison is the fact that in the decade under consideration, German expenditures for new construction have nearly trebled.

Science

The Stettin-Berlin Water Route.—The new canal connecting Berlin with the River Oder (and hence with Stettin, the nearest seaport to Berlin), will, it is expected, be completed by the autumn of 1912. It will accommodate vessels up to 660 tons. Undoubtedly the commercial importance of Stettin will be much enhanced at the expense of Hamburg by this new and short water route from Berlin to the sea.

Postponement of Scientific Congresses.—Owing to the disturbed state of public affairs in Italy, several international scientific meetings that were to have been held in Rome this autumn have been postponed. According to information received by the State Department in Washington, the International Congress of Tuberculosis and the International Congress of Archæology are now expected to be held next April. The International Geographical Congress has also been postponed until next spring, but the date appears not to have been settled.

The Geophysical Journal.—Under this title the British Meteorological Office is about to add to its long list of valuable periodical publications a monthly section of the British Meteorological Year Book, which will include daily data for meteorology, terrestrial magnetism, atmospheric electricity, etc., based upon observations at the Meteorological Office observatories and anemograph stations. An annual supplement will also be published, giving hourly values. This departure is in line with the advanced policy of providing material for synoptic studies in meteorology and related sciences for the benefit of students of dynamic rather than static problems.

Canadian Asbestos.—About 82 per cent of the world's supply of asbestos comes from Canada, according to an account of this industry published in the *Chamber of Commerce Journal*. The Canadian output has increased from 380 tons in 1880 to 63,300 tons in 1909. The quarries and factories are capitalized to the amount of $24,290,000. In the Black Lake quarries, Province of Quebec, there are 45,000,000 tons of asbestos in sight. The asbestos slate or shingle industry, a development of the last five years, has grown to such an extent that it is predicted that within a short time 75 per cent of all the asbestos produced in Canada will be used in making this new roofing material.

The Jesuit Seismological Service.—In the absence of a government seismological service in the United States, it is fortunate that a number of Jesuit observatories have organized a service, which includes stations at the following points: Buffalo, N. Y., Cleveland, O., St. Louis, Mo., New Orleans, La., Spring Hill, Ala., Denver, Colo., St. Boniface, Manitoba, Santa Clara, Cal.; Spokane, Wash.; Brooklyn, N. Y., Worcester, Mass.; Fordham, N. Y., Chicago, Ill., Milwaukee, Wis.; St. Mary's, Kan. The first nine of these are in full action, sending in regular reports to the central station, St. Ignatius College Observatory, Cleveland; whence they are transmitted to the International seismological headquarters at Strassburg, Germany.

Ozone and Ball Lightning.—W. M. Thornton, writing on "thunder-bolts" in the *Philosophical Magazine*, applies this term to ball lightning—though authority for such an application is not to be found in the dictionaries. The disappearance of one of these mysterious balls is said to be always followed by a strong smell of ozone. The writer believes that the principal, though perhaps not the only constituent of a ball of lightning is an aggregation of ozone and partially dissociated oxygen, thrown off from a negatively-charged cloud by an electric surge after a heavy lightning discharge. The explosion in which the phenomenon so often terminates is explained as due to the energy liberated on the transition of ozone to oxygen.

Powdered Milk for Polar Expeditions.—The announcement that two tons of powdered milk have been ordered for the use of Dr. Mawson's forthcoming antarctic expedition has helped to bring into prominence an industry which is assuming large proportions in Australasia, especially in New Zealand. The same product was used extensively by Shackleton's expedition, and was the principal food of Prof. David's party, which reached the south magnetic pole. New Zealand powdered milk is a serious rival to condensed milk, on account of its nutritive value and especially its keeping qualities. It is said to be much superior to condensed milk for infants' food, as it is thoroughly sterilized, contains no cane or beet sugar, and, in the process of drying the milk, the casein is divided into fine particles, as in human milk. One kind of powdered milk, made entirely from skim milk, is used largely in biscuit factories and in the manufacture of milk chocolate.

Aeronautics

Aeronautics in Italy.—The American consul at Venice reports that the first Italian school for the instruction of aerial pilots has been established and subsidized by the royal government at Pordenone, a town in the province of Udine. Italy's third military airship has been under construction during the past year.

An Aeroplane Service in the Congo.—According to the London *Times*, a government subsidy of $80,000 has been voted for the initial steps in the establishment of communication by aeroplanes over regions of the Belgian Congo that are still unprovided with railways and roads. It is proposed to traverse a desert 750 miles across, and to establish landing stations 250 miles apart fitted with wireless telegraphy. Each aeroplane is to carry three passengers and a relatively heavy load of food, water, tools, etc.

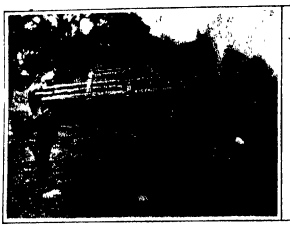
Carrying Mail by Aeroplane.—According to the report of the post office inspectors to the Postmaster General, no less than 43,247 pieces of mail matter were despatched by aeroplane from the Nassau Boulevard Aerodrome between September 23rd and October 1st. So enthusiastic has the Postmaster-General become as to the possibility of saving time and money in delivering mail in certain districts by aeroplanes, that he has asked for an appropriation of $50,000 to enable the Post Office Department to experiment thoroughly along these lines. Just as the automobile is at the present day rapidly replacing the horse in city mail delivery so the aeroplane will no doubt displace the fast express before many years have passed.

Results of the International Balloon Race.—The international balloon race which started about a month ago from Kansas City was won by Hans Gericke, the German aeronaut, who covered 471 miles. Lieut. F. P. Lahm, was second with 408 miles, and Lieut. Vogt, of Germany, third, with 350 miles. Fourth and fifth places went to John Berry and W. F. Assman, with 293 and 275 miles, respectively, to their credit, while Emile Dubonnet was sixth, with 200 miles. The French aeronaut remained in the air longer than any of his competitors but was blown back 400 miles. He has offered to wager $2,000 that he will beat any American who will come to France and fly against him between now and the first of the year.

Successful Use of Aeroplanes in Actual Warfare.—Cognizant of the excellent showing made by the aeroplanes in reconnaissance in the French and German maneuvers, King Victor Emmanuel sent to Tripoli with the armada, eight monoplanes and two biplanes. After flying over the fleet on October 23rd Capt. Piazza made a 45-minute flight in a Blériot monoplane about the neighboring country. The Arabs were awe struck when the machine swooped over them, and the theory that an aeroplane can be used for the purpose of creating panic was shown to be a correct one. The flight mentioned extended as far as the Zanzor oasis, some fifteen miles from Tripoli. Valuable information was obtained as to the disposition and numbers of the Turkish infantry.

The Trans-continental Flight.—Aviator Rodgers wrecked his machine in starting on a narrow road at Spofford, Texas, on October 25th. The day before he had covered the 132 miles from San Antonio, Texas, in 5 hours and 22 minutes, including stops of about 2 hours for repairs and the making of exhibition flights. This is the first bad smash he has had since leaving Huntington, Ind., but he remains undaunted and expects to eventually reach the Pacific Coast. Meantime, on October 24th, Robert G. Fowler has made another start in the opposite direction. He arrived at Mecca, Cal., at noon of the 24th ult., after having covered 61 miles in 68 minutes.

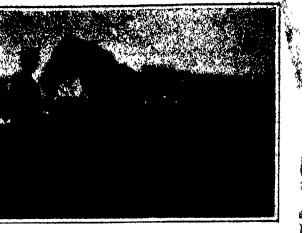
A New Hydro-aeroplane Record by Naval Officers.—On October 9th, Lieuts. Ellyson and Towers, of the Navy Aviation Corps, started on a flight from Annapolis to Hampton Roads with a Curtiss hydro-aeroplane. After flying five miles they were obliged to descend on account of motor trouble. Another start was made two days later, and this time the officers covered 65 miles and landed at Smith's Point, Virginia. A motor break-down terminated this second attempt. The third attempt was completely successful and was made on the 25th ult. The officers covered about 140 miles from Annapolis to within two miles of Fortress Monroe in 2 hours and 27 minutes, at the rate of nearly 60 miles an hour. The flight was made entirely above the waters of Chesapeake Bay and most of the way an elevation of 1,000 feet was maintained. The officers often shifted the control wheel from one to the other, and they were very enthusiastic over the operation of this new device which was brought out a few months ago by Mr. Curtiss and on which he has applied for a patent.



The mast packed for transit.

Wireless Telegraph Set for Cavalry

By the English Correspondent of the Scientific American



How the generator set is carried.

ONE of the recent developments of wireless telegraphy for military purposes is an equipment for cavalry use to insure a positive means of communication between bodies of mounted troops or with the main body and the commander in chief's staff

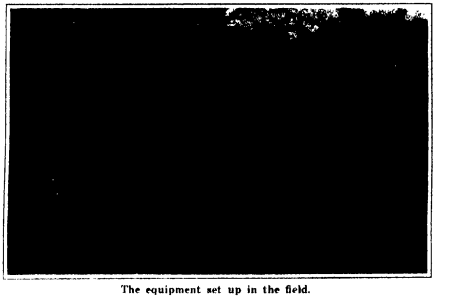
The installation is completely self-contained, comprising a small and light motor driving a dynamo a receiving and transmitting set, and a mast The whole outfit can be handled by a squad of four men and eight horses, four animals being required for the transportation of the parts One horse carries the generator set, another the transmitting instruments, the third the receiving equipment, and the fourth the detachable mast and the wire stays

The generator set is particularly interesting Secured to the saddle is a light outer framework of tube steel, with four side members projecting to serve as legs when the saddle is removed and stood on the ground Each pair of legs carries a lug and bracket near the ground to form a support on the one side for the small dynamo and on the other for the small gasoline engine Above each is fitted a semi-cylindrical tank to carry the fuel, oil etc It will thus be seen that the weight of the installation is fairly equally divided for the horse When the saddle and load is removed from the animal's back it forms a rigid structure on the ground The dynamo which is air cooled is direct coupled to the motor by a short length of detachable shafting slipped into sockets on the shafts of the engine and the dynamo respectively

The telegraphic instruments are of the latest Marconi type Both the receiving and transmitting apparatus may be packed into small compass so as to lie flat against the horses flanks The mast is built in lengths of about four feet which slip together in much the same way as the parts of a fishing rod, and when erected give a mast between 40 and 50 feet in height

The equipment shown in the illustrations is one of two that have been acquired by the Westmoreland and Cumberland Yeomanry of Great Britain and are identical in every respect with those recently employed in demonstrations in Turkey and in Spain They were submitted to a searching test on the occasion of the Investiture of the Prince of Wales at Carnarvon when they accompanied the Westmoreland and Cumberland Yeomanry which had been ordered to attend the ceremony One of the stations was established in the vicinity of Carnarvon while the other was set up at the head quarters some distance away By means of these two installations constant communication was maintained between the two points which did not possess other communicating facilities beyond a circuitous telegraph line also with the Royal yacht anchored off Holyhead and with the warships in attendance Communication was also secured between Carnarvon and Liverpool Heavy work was thrown upon the field station at Carnarvon as messages had to be received and distributed to all points

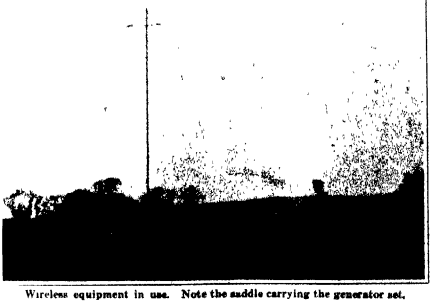
This regiment employs the two outfits regularly on maneuvers Within a few minutes of halting the company can secure communication with another mounted unit or the main camp while only a few minutes are required to dismantle the whole equipment and to pack it upon the horses' backs for transport The British War Office is following this development closely owing to its great military value, and there is every probability that similar sets will be distributed among the regular mounted troops



The equipment set up in the field.



The wireless cavalry squad with complete equipment.



Wireless equipment in use. Note the saddle carrying the generator set.

A PORTABLE MILITARY WIRELESS PLANT

Neglected Paestum

ONE of the noblest Greek cities of southern Italy was Paestum of the wild roses, and the site is of easy access A carrozzella will convey you all the way to Pesto from Sorrento or Pompeii, if you dislike railway trains Pesto itself is of course a malarial wilderness, over which three big Doric temples stand silent guard Qualified excavators have neglected the site to their shame, because these monuments and a Roman town wall seemed to survive the dead Greek city alone. Pesto is a buffalo pasturage. Piranesi's etchings of the old temples are familiar to print collectors, and one sees them painted and photographed a-plenty in the Naples art shops If our architects realized how superior they are to the over-extolled Parthenon in their rugged early Greek lines and masses, to say nothing of their glorious gray and orange weathering, they would copy their serried colonnades and their towering gables Wilkins surveyed them for his "Magna Græcia" Pesto is further the scene of a chapter in Hans Christian Andersen's fairly popular Italian novel "The Improvisatore"

In the face of all this modern notoriety, a German editor has been able to locate the ruins of Paestum or the Greek Poseidonia on the south coast of Sicily, and to credit Spinazzola with the discovery of those early Greek structures in 1911' His firm contention that the extant temples at Pesto originally occupied hilltops like other Greek temples, and that plentiful remains of the antique city lay buried between them, was the Neapolitan archeologist's real merit Spinazzola has proved his point with pick and hoe He began his probe at the two principal gates in the Roman wall Vestiges of the city's older, Greek gates were found under the Roman The next step was the location of a Greek 'Main Street" on the earlier level, along a line connecting the north and south gates An abundance of wall, gate, road-bed and house ruins, vases, terra cottas, lion head gutter spouts, bronze swords and spear heads, bracelets and brooches has rewarded the excavator's patience

Spinazzola's venture has incidentally enriched the Naples Museum's gallery of antique sculptures with a beautiful super-heroic statue of a real Roman hero, the elder Drusus The marble portrays the Augustan prince in a pontifical robe And above all, the majestic old temples of Neptune and Ceres crown the summits of their original terraced eminences again The seaboard settlement has recovered its twofold acropolis

Earth-eating in West Africa

HENRY HUBERT publishes in the *Bulletin du Comité de l'Afrique Française* an interesting account of the practice of geophagy in the French Sudan. Although the practice is common in many parts of the world, this particular case is remarkable for the systematic way in which the dirt is collected, and for the fact that it occurs in a well-cultivated region, where food is abundant The earth consumed is a clay, which is found intercalated among the grits of the region in beds of various thickness The deeper layers are preferred, and for this reason the natives dig galleries, which are so crudely constructed that falls of earth frequently occur, sometimes with fatal results When an unlucky miner is thus buried, no attempt is made to rescue him, as it is believed that the divinities of the mines require an annual victim. It is stated that individuals not infrequently consume seven and a half pounds of clay daily.

The Peking-Kalgan Railway

The First Railway Financed, Engineered and Built Solely by Chinese

By F. C. Coleman

IT is a fortunate circumstance for the Chinese in their contention for the full supervision of the expenditures of all railway loans from foreign syndicates, that the Imperial Peking-Kalgan Railway, which up to this time stands as the most difficult venture of its kind yet attempted in China, should have been financed, engineered and built solely by Chinese. Of even greater importance in support of this contention is the fact that this road has set a record for low cost of construction which, all things considered, has seldom been equalled. The Peking-Kalgan Railway runs from the capital of the Empire to the chief city on the caravan route to Russia. It is now 130 miles long and is being extended. It was built from the surplus earnings of the government-owned Imperial railways of North China, and from the first rough survey to the driving of the last spike no foreigner had anything to do with its construction. To-day its operation is entirely in the hands of the Chinese. That it was built in spite of natural obstacles to construction which foreign experts declared were absolutely prohibitive to any Chinese engineer and possibly even to themselves, is a personal triumph of no mean magnitude for the chief engineer, Jeme Tien Yow. That it was built at a cost almost without parallel for similar construction—at a lower figure per mile even than some of the foreign built roads on the level floor of the Yangtse Valley—is a striking object lesson for Europe and America, and will be a powerful weapon for the Chinese in their contention for fairer terms in borrowing foreign money. The line is now operating at a profit, so the directors of the Imperial Railways of North China have succeeded, not only in providing their government with a line that is strategically valuable, but with one that earns a return on the money invested. From first to last, the Peking-Kalgan line is a great triumph for the Chinese.

The name of Jeme Tien Yow stands out above all others in the record of the Peking-Kalgan Railway, and his achievements in connection with that enterprise alone are sufficient to have won him the undisputed title of China's leading engineer. He was one of a number of Chinese students who were sent to America about 1880 to receive university educations. Jeme Tien Yow was the only one who undertook a course in engineering. He graduated from Yale in 1888, and then went to a technical school in England for several years. On his return home he went into the employment of the Imperial Railways of North China, where, working under the British manager of that line, Mr. C. W. Kinder, he rose, post by post, outstripping many foreigners who were senior to him in point of service. Later he was appointed chief engineer of the Peking-Kalgan line.

Preliminary surveys were made for this line in the summer of 1905 and construction work was begun in October of the same year. At the end of nine months the first section of the line, 32 miles long and reaching to the mouth of the Nankow Pass, was completed. Chinese were employed in every department, from the lowest coolie or camel-driver up to the chief himself. The saving of the salaries of high-priced foreign officials, interpreters and various middle men became apparent at once. An even greater saving was found in procuring earthwork and similar constructive materials directly from petty contractors along the line, instead of giving the contract to big contractors and then paying all the commissions necessary in their system of subletting and resubletting contracts. This practice is not confined to China, but is carried to greater lengths there than anywhere else, and its abuse has been responsible for the great expense of so much work done by foreign syndicates in that country. For earthwork on this first division of the Kalgan line the average cost was about two cents per cubic yard; while after the Nankow Pass was reached and the embankments had to be made out of broken boulders, the cost rose to three cents a cubic yard. Broken stone for concrete was purchased for from 13 to 33 cents a cubic yard, delivered ready for use, and sand for the same purpose averaged about three cents. Most of this section of the line runs over a flat plain, gradually sloping to the mountains.

The Peking station is at Liutsin, a short distance outside the great wall of the capital, as very few Chinese railways penetrate the walls of any of the old cities, both on account of the lack of space inside and because of the violent prejudices of the conservative element of the people against such desecration. For some distance the line runs through a fertile farming country dotted with small villages. The most striking feature of this part of the journey is Waushoushan, the £10,000,000 summer palace of the old Empress Dowager, with its roofs of Imperial yellow tiles standing out strikingly against the green hillside upon which it stands. Shortly the country commences to show traces of erosive wash from the mountains, and before long the crossing of numerous cuts and "arroyos" of gravel and boulders begin. The bridges are all solidly built of steel and concrete, and the largest of them is nearly 300 feet long, having five 50-foot spans and one of 110 feet. The steel superstructure of this bridge—with the exception of the long span which was supplied from England—as well as of all the other bridges on the line, was built in the shops of a Chinese company at Shanhaikuan. The Liutsin section of the line has a total of 21 bridges and 17 drains, aggregating 1,352 linear feet of openings.

At Nankow are quarters for employees, machine shops, locomotive sheds and numerous other railway buildings of excellent construction. There is an up-to-date foundry in connection with the machine shop, where castings of any size required in locomotive and car repairing can be made. A well-equipped hotel, built and managed by the railway, fills a long-felt want of tourists. The Nankow Pass section the most difficult piece of railway engineering in China, was the next portion of the line to be built. This pass must have presented a very discouraging aspect to the Chinese engineer when, with the honor of his country at stake and with the "inevitable" failure, prophesied by all the foreign engineers in the East staring him in the face, he started over it for his tentative study. There is a rise of 1,800 feet in the 10 miles from the mouth of the pass to the summit at Pataling, and the gorge is so narrow that it seemed almost impossible in places to keep the necessary curvature without tearing down the mountain. Five distinct surveys were run, and on the earlier ones some of the curves were sharp enough to "break the back of a snake," as Mr. Jeme Tien Yow stated it. Slowly, and with infinite pains, a practicable route was determined upon, and along this the present line has been built. Even the most exhaustive surveying, however, could not solve all the problems, and at a point not far from the summit tunnel, where it was necessary to have a station and sidings, a zig-zag was introduced. However, a station being necessary, the inconvenience of the zig-zag was minimized.

The general direction of the railway up the pass is about parallel to that of the old stone-paved highway which leads down to Peking from the plains of Mongolia, the road over which all the Tartar invasions of the Chinese Empire have come since the time of Ghengis Khan. The general aspect of the country, in its rockiness and lack of heavy vegetation is strongly suggestive of some of the lower reaches of the more northerly passes of the Chilean Andes in South America. The railway up the pass is one continuous succession of cuttings, embankments, and tunnels. The embankments, regardless of their height, are for miles faced with cut and fitted granite blocks. All the overhanging boulders have been removed, or securely cemented into place even for hundreds of yards up the mountain sides, while the solid rock of the cuttings is trimmed as smoothly and evenly as if lined with plaster. The 19 bridges and the 36 culverts are all steel, concrete or cut stone, and in many instances where swift mountain torrents are crossed, cemented beds for the water prevent undermining.

The tunnels of this division are four in number, their respective lengths, in order as approached from below, being 1,200 feet, 150 feet, 450 feet and 3,570 feet. The first tunnel which was driven through limestone, was completed in about six months. The other three tunnels, all of which are in granite, were completed in good time. The one at the summit, the longest in China, took over a year. The summit tunnel, which runs under the Great Wall, was driven according to thoroughly up-to-date practice. A shaft was sunk near the half way point, and with the aid of fans, drilling machines and modern hoisting apparatus, work was carried on in both directions from the center, as well as from the ends of the tunnel. This shaft, with another, which was sunk to admit air near the northern portal of the tunnel, have since been lined with stone and retained as permanent ventilators. All the tunnels are lined throughout with concrete, which is also used for the portals. The open cutting in the pass, half of which is in solid rock, amounted to 640,000 cubic yards, while the embankments required an aggregate of 1,275,000 cubic yards of material. The latter, except such as was provided from the cuttings was obtained cheaply by blasting it out of the mountains close by. This earthwork labor cost only £44,000.

The third or Chatao-Kinmingyh division, 38 miles long, was of comparatively easy construction. There are 17 bridges and 32 drains in all 2,062 feet of linear openings. The principal engineering feature is a 1,000 foot bridge having ten 100-foot spans at Huilahsun. The fourth or Kinmingyh-Kalgan division is also 38 miles long, and in engineering difficulties rivals that of Nankow Pass. At Halangshupo 16,500 feet of granite and sandstone have been cut through to make a way for the line along the steep bank of the Yangho, the cutting varying from 10 feet to 85 feet deep. There are 2,075 linear feet of openings, 21 bridges and 130 drains. The coal in use is from a mine worked by the railway company near Haiahua, and the present output of 400 tons per day is ample for the railway requirements. There is a branch line 16 miles in length leading from Hsichihmen to the Mentoukou coal fields, which gives the product of these mines an outlet to the Peking market.

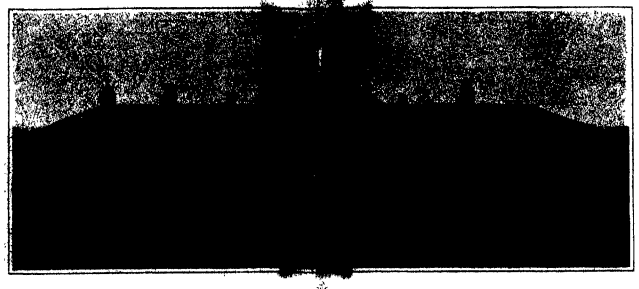
Of the character of the roadbed of this thoroughly built line the photographs give a very good idea. (See pages 401, 410, and 411.) The sleepers are mainly of Japanese hard wood of a class which would cost in the vicinity of a dollar in the United States, but which are laid down in China for less than half that figure. On the mountain divisions creosoted sleepers are used, with safeguards to prevent rail creeping. For the main line, which is of standard gage, 85-pound rails are used, for sidings and branches 60-pound rails.

The locomotives for the mountain divisions of the line are mostly "Mallet" articulated compound, as shown in two of the photographs, and they were built by the North British Locomotive Company (Limited) of Glasgow. Such of the passenger cars as have not come from the shops of the Imperial Railways of North China at Tongshan are of American manufacture, but the company will doubtless build all its own cars in future. The China-made cars are of a modified British type, a sort of a compromise between a side-door compartment car and one of the center aisle-type. The freight cars are of 30-ton capacity, and were mostly built by the Leeds Forge Co. (Limited).

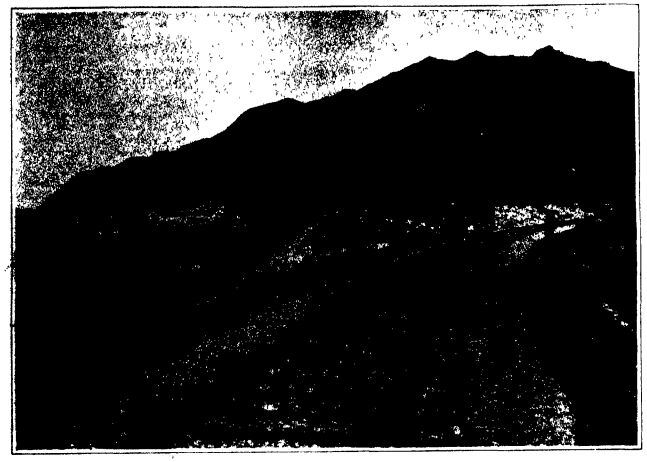
The Chinese Students' Journal makes this strong plea for Chinese control of expenditures in railway construction: "A railway line is not a clubhouse or a private mansion upon which the owner or owners may expend millions merely for the gratification of their sense of beauty or for an exhibition of their wealth, but it is a commercial investment. The amount of capital invested in it must be commensurate with its power of paying dividends, and in the case of Chinese railways the redemption of the bonds must not be for a moment forgotten. Economy on the Peking-Kalgan railway has been reduced almost to a science. There is no temptation to spend money recklessly, as no five per cent commission on every tael spent can enrich the coffers of any corporation. There are no engineers who must have foreign style residences, cement tennis courts, pneumaking machines, palatial house boats, and princely salaries before beginning work. There are no interpreters to browbeat the contractors to make trouble with the local officials, and to make a fortune in little or no time. All contractors deal with the engineers directly and no graft exists. The figures for the price of materials explain in a large part why a railway built under our own supervision and by our own engineers is so very much more economical. Another very important advantage gained is the peaceful condition of the coolies during construction, due to the absence of misunderstanding between engineers, the coolies and the country people. No disturbance of any kind, still less of any rioting, has ever happened and the work has proceeded so smoothly and quietly that the local officials are never called on to suppress disorders or punish offenders. There can be no unpleasantness arising through the interfering of foreign consuls and the referring of insignificant incidents to the minister in Peking. One and all understand that the railway is a Chinese railway, that our own money is being spent that the coolies are our own people though they are coolies, that the officials are officials appointed by the Emperor, and the result is that the work proceeds without a hitch of any kind."



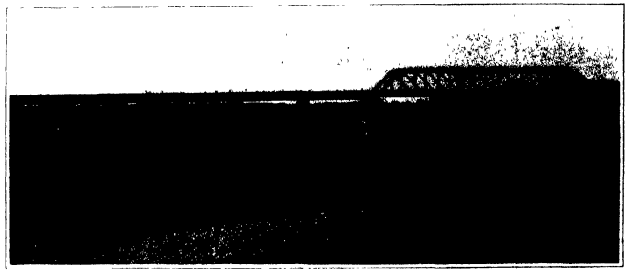
An example of heavy cut-and-fill work.



Kalgan Station, the [illegible] of the railroad.



The hand-car looks incongruous under the shadow of the great wall.



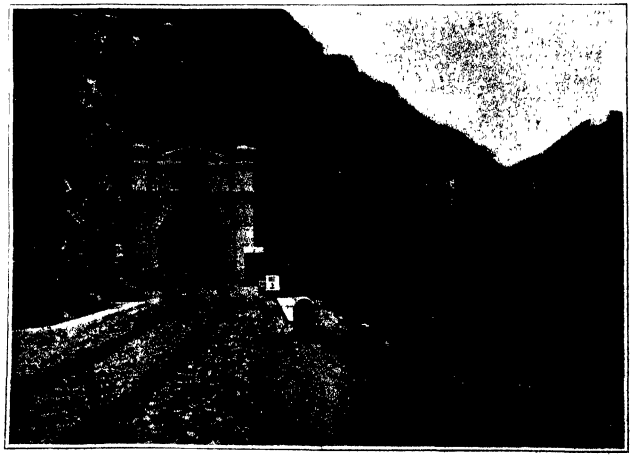
A typical bridge over one of the smaller streams.



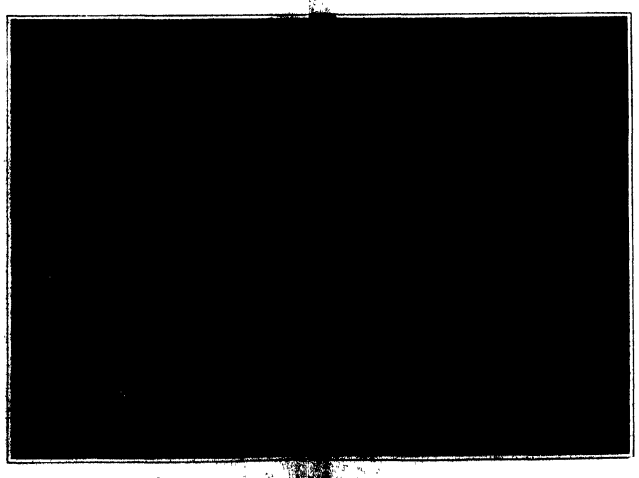
Engineers who built the railroad; [illegible]ow, the chief engineer, in the center.



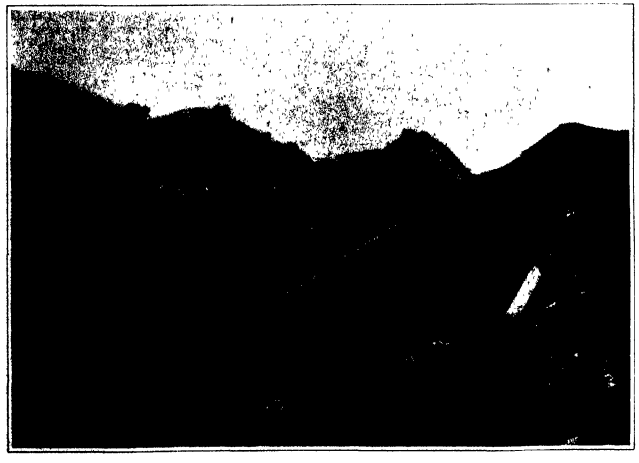
One of the longer bridges. The piers are built of concrete



A short tunnel. Note the peculiar railroad signal posts.



A typical oriental scene [illegible] streams along the line.



Curious mixture of old and new: tunnel, culvert and great wall.

THE PEKING-KALGAN RAILWAY—THE FIRST RAILROAD [illegible], ENGINEERED AND BUILT SOLELY BY CHINESE

The Laboratory

Some Suggestions for Home Experiment

Microscopic Photography

By Norman Borden

IT is the purpose of this article to give a definite idea of how photomicrographs are made and at the same time to give the possessor of a microscope precise and accurate directions for obtaining photographs of microscopic objects.

The entire apparatus consists of a microscope and accessories, camera, shutter and body, rack for carrying the camera and if necessary a source of artificial light. Fig. 1 shows most of the pieces of apparatus which are to be considered separately in the following paragraphs.

First the quality of the objectives must be taken into consideration. A chromatic objective is entirely out of the question for making high amplifications. An achromatic objective free from scratches, must be used in securing high power negatives. Objectives of 3, 4 and 16 millimeters focal lengths will be found to suffice for amplifications up to 1,000 diameters. Also if the eyepiece is to be used in connection with the objective, both lenses must be perfectly clean. One method of cleaning lenses is to wash them in a solution of tincture of green soap and distilled water, using absorbent cotton, and, then, as a final, to rinse them in pure grain alcohol.

One form of a frame work for carrying the camera is shown in Fig. 1. The base *B* is large enough to accommodate a stereopticon or other source of light. The uprights *A*, of which there are two, should be made of metal rods or tubes. They must be fastened rigidly to the base and if necessary strongly braced. It is of great importance to have the apparatus as rigid as possible so that it will not vibrate. Four feet is a suitable length for the uprights. In constructing the camera and bellows, the main object is *to get them light tight*. For the bellows rubberized cloth will be sufficient. The plate holder is made to slide upon the uprights and is provided with thumb set screws so that it may be fastened at any position. If a regular camera shutter is not at hand the exposing can be done by using a cardboard before the mirror of the microscope.

Perfectly white light gives the best results. Sun light may be used if the photographer is provided with a heliostat. The student had better resort to an artificial light such as gas or electric light. The tungsten light is the best of the convenient incandescent lamps. If this lamp be used as shown in Fig. 1, its light will be found sufficient for all magnifications up to 1,000 diameters. If the gas mantle is used the stereopticon should be provided with a number of light trapped ventilators. Monochromatic light can also be used to advantage with certain objects. This kind of light is obtained by the use of ray filters which absorb all the light except the color wanted. A substitute for true monochromatic light is the light which passes through a cell containing ammonio-sulphate solution. This last named light is also free from heat waves so that there is no danger of softening the mounting media while making long exposures. Fig. 2 shows how such a cell may be made. There are times, too, when dark ground illumination will be wanted. This is effected by stopping out the light immediately behind the object with some opaque substance put on the front lens of the condenser. When done properly, a cone of oblique rays illuminates the object and gives it more relief so that it has a natural appearance.

The appearance of the object in the negative has to do with the plate used. Isochromatic plates give truer color values than the ordinary plates. Fast plates can be used to an advantage over the slower ones.

Working Directions.

We will begin by picking out an object that is suited for photography, namely, a diatom "Triceratium Favus," which is generally the first one of prepared diatom plates. The diatom is placed in the center of the field and then the microscope is put in connection with the camera by means of a small rubberized tube. The magnification will be about 200 diameters, so the camera is fastened in its position and a rough focus is made. The finer details cannot be seen on the ordinary ground glass, so a focusing glass is used and a piece of plain glass is substituted for the ground glass. In this last named method of focusing the actual image is used to focus upon and it must be in the same plane that the sensitive surface of the plate will be. The light is adjusted while focusing, by means of the iris diaphragm.

Rules for exposing cannot be given in precise statements. With a heliostat, 5 millimeters objective and 400 diameters amplification, the exposure would have to be about 2 or 3 seconds. Using light from the clear blue sky, an exposure of 30 to 90 seconds would be made for an amplification of 50 to 75 diameters. The *time of exposure depends* upon the light used, the *color* of the object, the plates used and the magnification. The one aim in making photomicrographs is to produce a dense negative with contrast.

Developing and Fixing.

As there are a great number of reliable developers on the market it is not advisable for the beginner to mix his own. Develop the plate until the details show from the back of the plate and then rinse in plenty of water and transfer to the fixing bath. Here it should remain long enough to clear the last traces of silver. The negative is then washed and intensified if necessary. To intensify, immerse the plate in a saturated solution of mercury bichloride until it is bleached white and wash thoroughly. Next immerse in a solution of ammonium hydroxide (about 10 per cent) until the film turns black again. This method produces intensification to a moderate degree.

Preparation of Specimens.

Epithelial cells are good objects for practising mounting and staining. They are found in a free condition in the saliva, the microscopic constituents of which are (*a*) the salivary corpuscles, which are about the size of the white corpuscles of the blood (8 to 10μ); (*b*) the pavement epithelial cells; (*c*) living organisms from the cavities of the teeth; (*d*) leptothrix buccalis, which are large rod-shaped bacteria. All these objects are well suited for photography when deeply stained with fuchine and mounted in balsam. Fig. 3 shows an epithelial cell with bacteria.

In Fig. 4 is seen a group of micrococci, which were cultured on a slice of potato. They are easily stained mythel-violet and mounted in Canada balsam. The spores of the fungus, Aspergillus Glaucus, magnified 500 diameters are seen in Fig. 5. Fungus spores do not need be stained and are best photographed dry. Among other objects are pollen grains, sections of plant stems and plant hairs. The stagnant water in frog ponds contains innumerable specimens.

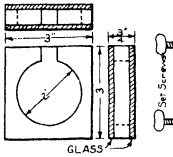


Fig. 2. Cell for ammonio-sulphate solution.

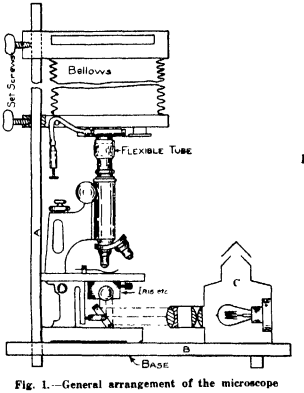


Fig. 1.—General arrangement of the microscope and camera.

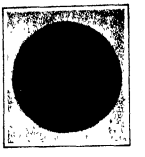


Fig. 4.—Micrococci cultured on potato.

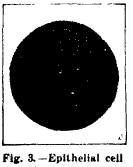


Fig. 3.—Epithelial cell with bacteria.

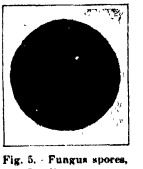


Fig. 5.—Fungus spores, 500 diameters.

A Heat-storing Water Bag

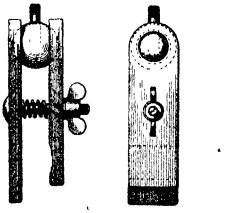
THE bag described in the following paragraphs is a great improvement over the ordinary hot water bag. Besides its property of retaining heat longer, it can be prepared so that it will store heat, be set aside and then used at a future time. It is then ready for any emergency. Fill an ordinary hot water bag with either sodium sulphate crystals or hypo crystals. The crystals cost about ten cents per pound at the drug store. Sodium sulphate is preferable. To use, place the bag, which should be tightly corked, into a vessel of boiling water, and boil for about fifteen minutes. The crystals in the bag are now in a liquid state, i. e., a super-saturated solution has been formed. The bag is now ready for immediate use. It will now impart its heat steadily about four times as long as the same weight of water. If the bag becomes cold in too short a time, it is a sign that it has been boiled too long.

To prepare the bag for future use, boil twice as long as you did for immediate use. You can if you wish, use the bag while it is giving off its temporary heat in cooling, and then later utilize its latent heat. The storing qualities of the bag depend upon the heat of crystallization. The solution in the bag has become super-saturated by long boiling of the bag. Upon cooling it remains a liquid, but if it is touched by the cold fingers or suddenly jarred, or if one of its crystals is inserted in the solution, the whole mass crystallizes, and the heat of crystallization is given off. Sometimes the solution on solidifying forms in one hard lump. This does no particular harm, but it may be prevented by kneading the bag at intervals while in use.

Ball Clamp for Holding a Camera

By J. H. Bentley

A BALL clamp for holding a camera to any suitable support may be made very simply as follows: Two clamp plates should be fashioned out of a 1¼-inch by 5/16-inch stick of wood, one being 4¾ inches long and the other 4¼ inches. A ⅜ inch hole is drilled at one end and countersunk on the inside, the other end



A camera-supporting clamp.

of the short one being cut away as shown to give the clamp a good grip on angles. Very often a wooden ball can be found on the end of broom handles or a discarded child's ten-pin set, knobs, etc. The stud in the ball is ¼-inch-24 thread, for standard cameras, and is pressed tight into a hole drilled for it.

The cup-head bolt is also ¼-inch-24 and the inside of the head should be filed a very obtuse V as shown to prevent turning and to form a rocking fulcrum when on an angle. The spring on it keeps the clamps apart.

The Inventor's Department

Simple Patent Law; Patent Office News; Inventions New and Interesting

A Confederate Patent Discovered

ON the 23rd day of August, 1861, the Confederate States of America granted Letters Patent, No. 13, to P. R. Clements of Eufaula, Ala., covering an improvement in water wheels. The original of this patent, which is in the possession of a Washington patent attorney, is the only one known to the United States Patent Office to be at present in existence. Its whereabouts was discovered by Mr. James T. Allen, a first assistant examiner in the office, and one of the oldest employees in point of service, now in that bureau. Mr. Allen entered the Patent Office in September, 1868, several years after the Confederate States of America ceased to exist, but he has always been interested in the collection of statistics and information regarding the work of American inventors.

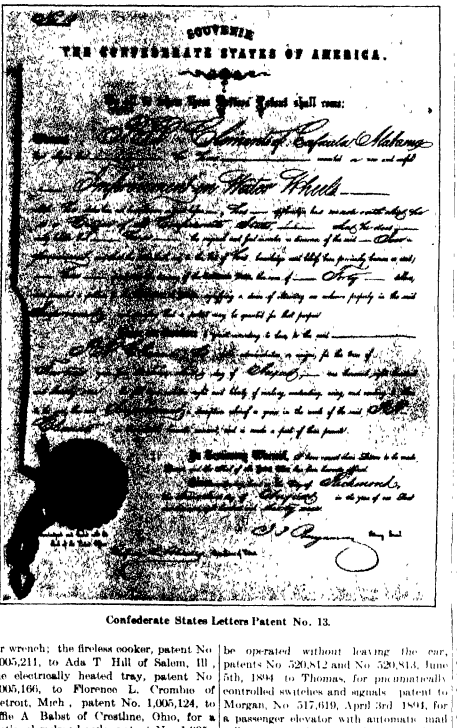
Mr. Allen obtained the loan of Confederate Patent, No. 13, and at his own expense had a plate made, from which the reproduction on this page is taken. There are several interesting features about this patent. It will be noticed that the term of the patent is fourteen years, whereas at that time United States patents were granted for a term of seventeen years, the period having been extended from fourteen to seventeen years by the Act of March 13th, 1861, nearly six months prior to the date of the Clements Confederate patent. The fee is fixed at forty dollars, which is very reasonable, considering the fact that the present fee for a United States patent is thirty-five dollars. Confederate money is not specified in the grant, but it is to be presumed that that currency was the proper legal tender in the Confederate Patent Office. The grant bears the signatures of J. P. Benjamin, the first Confederate Attorney General, and of Rufus R. Rhodes, Confederate Commissioner of Patents.

There is room for conjecture in the serial number of the patent, data as to the previously granted patents, a round dozen in number, are not available. The patentees under these may long ago have faded into dust, the inventions may be as worthless as the grant under which they were issued. Whether or not thirteen was the sum total of patents issued by the Confederate States is not known. Perhaps in the possession of some old family of the South are the original records of the long-forgotten Patent Office of the Confederacy. These alone can answer the question. Perhaps, carefully guarded as priceless mementoes of the past, are scattered here and there throughout the land of Dixie the yellowing documents granting exclusive rights to inventions long since forgotten or superceded.

The pages of history are always being reopened in this way. Looking down the long vista of years, one can see the struggling states south of the Mason and Dixon line, who believed in the right as they saw it, and sacrificed their all to support their convictions. When P. R. Clements of Eufaula, Ala., was handed Letters Patent, No. 13, of the Confederate States of America, the paper was clean and crackling and the signatures on it were scarcely dry. High hopes bounded in his bosom as he realised that for fourteen years he would have protection in which to enjoy the fruits of his toil. Even now his improved water wheels may be turning in some hamlet of the Southland, grinding the meal that is to form the daily bread of its citizens—citizens of the Confederacy no more, but citizens of the United States, the nation that has recently issued its millionth patent. But the holder of that millionth patent, which has been so widely advertised and so lauded as being typical of the great achievements of the American brain, was not more proud of his possession than P. R. Clements of Eufaula, Ala., when he was granted No. 13, of the Confederacy.

Women Patentees in One Issue

AS showing the activity of the ladies along inventive lines, it may be noted that among the patents issued October 10th, 1911, are found many to women inventors. These include Ada Lutton of Revere, Mass., who patents, No. 1,005,244, a ribbon renovating device, Evalena O. Leggett of Niagara Falls, N. Y., whose patent, No. 1,005,240, is for an insulating compound; patent No. 1,005,213, to Hattie D. Hinds of Rutland, Vt., for a jar wrench; the fireless cooker, patent No. 1,005,211, to Ada T. Hill of Salem, Ill., the electrically heated tray, patent No. 1,005,166, to Florence L. Crombie of Detroit, Mich., patent No. 1,005,124, to Effie A. Babst of Crestline, Ohio, for a sectional railroad rail; patent No. 1,005,542, to Ada Harmer of St. Louis, Mo., for a stand and gage for dress makers, patent No. 1,005,575, to Estelle C. Raney and Charles E. Simmons of Steubenville, Ohio, for an automatic circuit breaker for electrical distribution systems; Mary E. Van Luven, Oakland, Cal., No. 1,005,675, for an irrigating vessel; No. 1,005,752, to Jennie R. Sherrod of San Francisco, Cal., for a hook for hooks and eyes.



Confederate States Letters Patent No. 13.

Patents That Expire This Year

AMONG the many patents for important or representative inventions which have or will expire during the year 1911 may be mentioned the patent to Smethurst, No. 520,902, June 5th, 1894, for potato harvester; the seed drill patent, to Schopp & Liese, No. 513,060, January 16th, 1894, patents to Pitt, No. 516,745, March 20th, 1894, and to Stevens & Swart, No. 519,460, May 8th, 1894, for transplanters, the patent, No. 521,629, to Popp, August 14th, 1894, for preserving the sugar making machine of Moondes, No. 514,238, February 6th, 1894, patent No. 522,132, June 26th, 1894, to Van Ruymbeke, for distilling glycerine, patent No. 528,322, to Castner, October 30th, 1894, and to Crapney, No. 520,257, May 22nd, 1894, for the electrolytic production of caustic soda, sodium carbonate and chlorin, the patent to Coyle, No. 518,394, April 17th, 1894, for sewer construction, No. 522,782, to Clouser, for a railway switch which can be operated without leaving the car, patents No. 520,812 and No. 520,814, June 5th, 1894, to Thomas, for pneumatically controlled switches and signals, patent to Morgan, No. 517,619, April 3rd, 1894, for a passenger elevator with automatic mail collecting and delivering devices, Sellers, No. 520,940, June 5th, 1894, for armature winding, patents to Scott, June 5th, 1894, No. 521,051, and to Hunting, February 20th, 1894, for electric motive power; Fiske, No. 529,484, November 20th, 1894, for printing telegraph, the Copeland patent, No. 520,110, November 13th, 1894, for bicycle crank shaft fastening, dispensing with the connecting keys. Greater strength as against telescoping or crushing in collisions and other accidents is sought by a rolled steel plate construction in a patent, No. 512,960, of January 16th, 1894, to Jewett. Miller's patent, No. 516,084, March 6th, 1894, for cable transportation, patents No. 516,053, March 6th, 1894, to Hulett, and No. 527,117, No. 527,118 and No. 527,119, to Lay, October 9th, 1894, for coaling steamers, No. 518,895 of April 24th, 1894, to Porter, for handling hay, and No. 515,200 of February 20th, 1894, No. 526,849, of October 2nd, 1894, and No. 530,232, of December 4th, 1894, to Loudon, for means for unloading hay, the Burgess patent, No. 520,772, of May 29th, 1894, for automatic fire arms, the hot water car heating patent to Towne, No. 512,239, of January 2nd, 1894, patent to Bicknel, No. 526,364, September 18th, 1894, for a brushing machine, the shoe insole channeling machine, patent to French and Meyer, No. 529,900 of November 27th, 1894, the stitch separating and welt indenting machine, patent of Hadaway, No. 521,978, of June 26th, 1894, the patent, No. 528,128, of October 23rd, 1894, to Julian, for sole-rounding machine, patent to Dunbar, No. 521,243, June 12th, 1894, for machine for making screws, bolts, etc., Klatte patent, No. 523,432, July 24th, 1894, for chain making machine, the Coffin patent No. 512,094 of January 9th, 1894, and the Hunter patent No. 520,960, May 22nd, 1894, for electrical welding of metal, patent No. 511,705, February 14th, 1894, to Cornell, for label affixing machine, patents to Barry, January 2nd, 1894, No. 511,745, and to Ethridge, No. 521,005, June 19th, 1894, for mail marking machines, the Goodson patent, No. 530,181, December 4th, 1894, for typesetting machine, the Northrop loom patent No. 529,943, November 27th, 1894, patent No. 517,705, April 3rd, 1894, to Morgan, for machine for dovetailing box blanks, clothes pin making machine, No. 513,572, to Hall, January 30th, 1894, tooth pick machine, No. 521,734 and No. 521,739, June 19th, 1894, Seamman, No. 515,506, February 27th, 1894, to Sherman, for floor-board boring machine, automatic screw driving device to Briggs, No. 529,701, November 27th, 1894, No. 526,068, to Davis, September 25th, 1894, for rotary machine, the photograph burnisher to Bolles, No. 527,-315, October 9th, 1894, and magazine camera No. 522,924 to Spooner, July 10th 1894, illuminating life preserver to Guest and Bates, No. 512,057, January 16th 1894, apparatus for oiling waves, Hallett, No. 529,479, November 20th, 1894, marine torpedoes, Holland No. 522,177, June 26th 1894, and Baker No. 530,866, December 4th 1894, Gorham, No. 527,-952, invalid lad.

Inventors' Permanent Exhibit in London

CONSUL-GENERAL JOHN E. GRIFFITHS, in an official communication published by the Bureau of Manufactures is quoted as saying:

"It is stated that a permanent exhibition will be held in London for the benefit of inventors. The exhibition is to be kept open throughout the entire year and inventors will be afforded the opportunity of displaying their patents to possible purchasers not only in the United Kingdom, but from all parts of the world. It is purposed employing expert demonstrators, who will take visitors through the various sections of the exhibition and who will have technical knowledge of the sections with which they are specifically connected.

"Through this exhibition which has a financial side it is hoped to bring inventors who are anxious for promising patent in which they may place their money in touch with patentees who not have something of real value to offer but who are unable frequently, under existing conditions, profitably to dispose of their inventions."

Invention Necessary to Patentability

WE are constantly coming new things that seem ingenious and many times important, but which cannot be protected by patent because they do not possess or

involve the prime essential to patentability invention A thing may be new and it may be a useful purpose, but if it stops there and does not involve invention, it cannot be protected by patent, because patents are the reward for the products of invention Jim Walker says "Patents are given for things invented, and not for doing otherwise produced" He also announces the absence of any universal affirmative rule for determining whether invention exists, but gives a number of negative rules, thus emphasizing the difficulty of determining what is or is not invention but in no way affecting the fundamental principle that invention is necessary to patentability, thus dignifying and elevating the patent grant Many inventors have not the mechanical skill to produce the invention in physical form and it is not necessary that they should have it for it the inventor conceives and supplies all the inventive ideas he can employ mechanical assistants in the production of the actual embodiment of his invention

Notes for Inventors

A Sensible Night Signal for Automobiles.

—Many of the most serious automobile accidents are due to a misunderstanding or ignorance of the driver's intentions, and so a system of hand signaling has come into vogue, which, although crude, answers many purposes so long as the driver of one car is enabled to see that of another At night such communication between the car operators is impossible A real signal has been devised for the purpose It is electrically operated and consists of three lamps and a horn A red lamp is fit permanently while above is a green lamp, which, being flashed, signifies that the driver is about to stop To the right and left are white lamps, signifying his intention to turn to the right or left These signals are all electric and are operated by buttons, conveniently placed for operation by the chauffeur As any one of these signals is made, the horn is sounded to attract the attention of anyone who may be following

An Illuminated Life Preserver.—An illuminated life saver has been on trial for some time in the German navy and so highly is it regarded that it is likely to be adopted for use on the warships It consists of two long floating cushions, which are secured on the chest and back, passing over the shoulders, and which are strapped in place somewhat after the fashion of a knapsack This shape is said to support the body in the water much more comfortably than the life preservers of older form This apparatus is equipped with an electrical lamp, supplied with current from a battery, and the lamp is automatically thrown into action upon the buckling of the belt around the person This feature is regarded as of great value in some kinds of accident, especially those at night, and in times of peace, although in warfare it would not always be desirable

Street-car Letter Boxes It was objected to early letter boxes for use on street cars for the collection of mail matter, that where the openings were of sufficient size to permit the deposit of mail conveniently, they also permitted the entrance of rain, which generally had a serious effect, causing the envelopes to become unsealed and address es effaced or at least rendered illegible The postal authorities are conducting some experiments at Washington with a street car equipped with a letter collecting box which is proof against the entrance of rain The box has a large opening with sloping sides which facilitate the passage of mail matter without regard to size or number of pieces deposited The sides of the opening are supplied with a double arrangement of gutters which catch all raindrops and carry the water away from the mail matter in the box

The Humors of Patent Specifications

The ideas of different people as to the usefulness of a device necessary to support a patent are sometimes very amusing A patent was once granted for a cube-shaped device, intended for use by card players, as a tally block, and in the original specification, the inventor, either from a sense of humor or from a misunderstanding of what was required in applications for patent, described some remarkable utilities for the device Thus he writes.

"Besides the above mentioned conveniences to a card player, I claim it to become a constant companion to present humanity and countless millions to come The man of business will carry it in his coat pocket and rejoice to be in a position to meet any emergency A hole in his pocket does not bother him as he can carry his loose change in the tally block The sponge can be changed at will containing the perfume that shall permeate his clothes, walking about on the street his nose is apt to offer a good landing place for soot, the little mirror on tally block keeps him from rubbing at it xxxed and spitting on his handkerchief, the sponge will perform that duty No fear of foot pads as a corner of the tally block on the top of his head with a gentle pressure will make quite an impression Coming home baby cutting teeth and is cross will change into a smiling miracle when papa pulls out the tally block and juggles with the dice box, its attention being riveted the pain is all gone Coming late from a lodge meeting and the key being about one inch out of his reach on the transom, the tally block is as good as a step ladder In case wifey thinks she has heard a noise in the cellar or wants him to look at the gas meter, the tally block answers the purpose of a candle holder To a poet with inspirations or those who wish to keep record of a dream and write in the dark, nothing takes the place of the tally block"

and so on for many paragraphs of the same kind of matter, which, needless to say, were eliminated before the actual issue of the patent

There are Cops and "Cops"—The examining corps of the Patent Office is of an unusually high order of intelligence and the members are generally acquainted with the various arts Sometimes amusing things occur when an examiner fails to understand a technical term well known in another art A "cop" is defined as "the conical roll of thread formed on the spindle of a spinning machine" In an application, now issued, and consequently a public record, the applicant referred to an illustration as "the representation of a cop" Not understanding the word, the examiner wrote, seriously, a letter in part as follows

"The attention of the examiner being called to this case, he regrets it as in no condition for official judgment on the merits Applicant shows a device which the examiner would be inclined to regard as the familiar method of a ball of twine Applicant says however it is 'the representation of a cop' It does not look like a policeman, which to the examiner's mind is the popular signification of the word cop, and consequently the word requires some limitations"

The Inventive Convict.—That all people, even hard-hearted jailers, are interested in inventors and inventions is shown by the following story Some years ago a Washington patent attorney was called on by a man from the West who had an improvement in some refrigerating apparatus and prepared and filed the application for patent, the inventor leaving ostensibly for home A few days later the attorney received a telegram from the sheriff of the inventor's home county, asking whether he was in Washington, and replied that he had been but had left for home, and later received from the sheriff an explanatory letter to the effect that the inventor had been committed to jail for some offense and while in the sheriff's custody had developed the invention in which the sheriff had taken an interest, that he had, on his own responsibility, released the prisoner temporarily, so he could go to Washington to secure the patent and then return to serve the balance of his term So far as known, the sheriff is still waiting his return

Sectional Book Cases.—An early instance of a construction capable of being utilized in a sectional book-case is shown in the expired patent to Spruce, No. 224,486, patented February 10th, 1880 While specified as a post-office box, the patentee described each box as a complete and independent structure in itself, so that in arranging a number of boxes together, this single complete structure enables the placing of them in series vertically and horizontally, according to the space required to be filled, and that the boxes may be made and held in stock, from which orders may be at once filled for a number of boxes, without regard to the space to be filled by the boxes.

A Japanese Appreciation.—A government publication tells how the Japanese government, in proceeding to establish a patent system under their patent act of March 1st, 1899, sent, as a special commissioner, Mr Korekiyo Takahashi, to the United States to examine into our patent system At that time, Mr. Perry B. Pierce, now deceased, was examiner of designs, and Mr Takahashi had many interviews with him. In one of these, Mr. Pierce asked the Japanese commissioner why the people of Japan desired a patent system, and Mr Takahashi replied: "You know it is only since Commodore Perry, in 1854, opened the ports of Japan to foreign commerce that the Japanese have been trying to become a great nation, like other nations of the earth, and we have looked about us to see what nations are the greatest, so that we could be like them, and we said 'There is the United States, not much more than a hundred years old, and America was discovered by Columbus, yet four hundred years ago,' and we said 'What is it that makes the United States such a great nation?' And we investigated and we found it was patents, and we will have patents." In repeating the interview, Examiner Pierce declared that. "Not in all history is there an instance of such unbiased testimony to the value and worth of the patent system, as practised in the United States"

A Patent Office Rival of Tom Sawyer's.—A story is told of the chief clerk of the United States Patent Office, Mr William F Woolard, which is in the class with Mark Twain's famous account of how Tom Sawyer escaped the irksome task of whitewashing a high board fence, by persuading his playmates that such work really was a rare pleasure in which an ordinary boy had no opportunity to indulge. In his boyhood days the chief clerk lived in Fairfield, Ill., and it was his duty on Saturday to cut the wood for household use during the week The burdensome task was increased by having to carry the wood to the wood-house, fifty yards away. To relieve himself of that burden, young Woolard erected an inclined track and constructed a small flat car, so that no labor was involved in sending the loaded car down or the empty car up the track. Its availability as a gravity railway for pleasure riding was soon discovered, and when the boys of the town began to so use it, while the builder was industriously engaged at the wood-pile, a halt was called Each boy was required to cut a carload of wood in order to be entitled to a free ride. On Saturdays there was a procession of boys with axes and saws, and the wood-yard looked like a husking bee, with the result that the wood-house was soon filled to overflowing When this condition was reached, the elder Woolard would not meet the further demand for more cord wood

Snow Melting Apparatus.—A snow melting apparatus in which the snow in finely separated particles is passed into a melting chamber and heat is applied to the snow particles while finely separated is presented in a patent (No. 1,004,113) to Garry B Van Wye of New York city.

Milk and Cream Mixing Can. -To prevent most of the cream from passing off with the first milk poured out of the can, Newton Sherman has patented (No.1,004,-919) a milk can with a cover and with a milk and cream mixing device which is independent of the cover and can be operated from the outside of the can without removing the cover.

Disinfects Book Leaves.—As described in a patent (No 1,005,080) Thomas H. Hood of Greenville, Miss., disinfects books by spreading or opening the leaves by a current of air and utilizing the same current of air to deliver a disinfecting substance to the leaves.

RECENTLY PATENTED INVENTIONS.

These columns are open to all patentees. The notices are inserted by special arrangement with the inventors. Terms on application to the Advertising Department of the SCIENTIFIC AMERICAN.

Pertaining to Apparel.

HAT.—H. BENSEL, 520 Fifth Avenue, New York, N. Y. This invention is an improvement in women's hats, and has in view a binding at the edge of the brim which will securely connect the inner and outer facings of the hat together and keep the lining and covering, if such should be provided, well stretched out, and give this part of the hat a finished appearance.

Electrical Devices.

INSULATING COMPOUND.—EVALENA O. LEGGETT, 1630 Michigan Avenue, Niagara Falls, N. Y This compound is more especially adapted to the insulating of electric wires or cables. It will act as a perfect insulator, and will be unaffected by ordinary variations of temperature. It can be applied after the manner of paint, which will dry quickly and will not crack or clip off. It is also a waterproof compound which will not "sweat."

APPARATUS FOR EXPLODING MINE CHARGES.—J. KRANNICHFELDT, (Schuis-Agent) Cologne, Germany. Former intermediate switches were driven by clockwork, so that in exploding all the charges in a mine one is bound to the time of the clockwork. To overcome this drawback and to enable the charges to be exploded at desired intervals—if necessary only after examining each circuit—the intermediate or local switch, according to this invention, is controlled, adjusted or operated by electric means from a distant and therefore safe central station.

ELECTRIC PUSH BUTTON—J. L. MORRELL, 15 Audubon Avenue, New York, N. Y. This invention provides a resilient rest for the plug employed in push buttons which forms an even support therefor to avoid the rocking of the button when depressed to complete the electric circuit in which it is incorporated, provides contacting members for completing the circuit arranged to avoid the carbonizing thereof, extends the supporting base of the resilient member of the button, and reduces the labor of assembling the button.

Of Interest to Farmers.

MACHINE FOR PICKING FEATHERS FROM FOWLS—C. W SMITH, care of Swift & Co., Produce Dept., Fort Worth, Texas An object of the inventor is to provide a machine for picking feathers which will effectively accomplish the operation without injury to skin of the fowl A further object is to provide a device by means of which the feathers may be removed in a much less time than in the ordinary manual operation

SWEEP RAKE—E. B ROCK, Route No 3 Studley, Kan In the present patent the invention has reference to an improvement in rakes of that class which are known as sweep-rakes or drag-rakes and which are provided with long gathering teeth that project in front barker removes bark from logs which are to wheels

HAY STACKER—E B ROCK, Route No 3 Studley, Kan In gathering hay in the field and conveying it to the stack, large wheeled rakes commonly known as sweep-rakes are employed As the stack grows in height, the difficulty of delivering the hay thereon increases correspondingly, and, to facilitate the operation, portable frames, called hay-stackers, are frequently brought into use The invention is an improvement in this line.

SCOOP FOR EMPTYING PANS—R. J ROSS, care of L C Corey, Harbison-Walker Refractories Co., Portsmouth, Ohio. This improvement provides a shovel or plow which is mounted to rotate on a shaft disposed over the pan so that it may be rotated into or out of operative position, a lever being pivoted to the plow and being adapted to engage a ratchet in a sector member for holding the plow in a predetermined position.

Of General Interest.

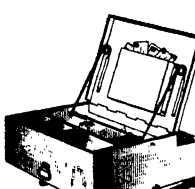
DISPENSING APPARATUS—L. K LARRISON, Wharton, N. J. This invention refers to a device whereby a predetermined amount of liquid can be dispensed from a bottle or other receptacle An object is to provide a receptacle with an internal receptacle or conduit adapted to receive any predetermined amount of liquid from the first-mentioned receptacle, to remove the same from the said receptacle.

COLLAPSIBLE TUBE.—C. H STUART, Newark, N. Y. In the neck of the tube is a valve by which the discharge of the paste or liquid from the tube is readily controlled, the valve embodying a piston extending crosswise of the neck of the tube and having a discharge passage in its length movable into register with the discharge passage of the neck, the valve having enlargements at each end, one exteriorly arranged and constituting an operating member by which the valve is revolved, and the other preventing the valve from being drawn from the neck.

BANDED BARKER.—I. RICHARDS, care of F. A. LONG, An Sable Forks, N. Y. This barker removes bark from logs which are to

ends up into paper pulp, and the invention particularly relates to reinforcements, in the nature of bands for strengthening and lengthening the life of the barker. The barker comprises a plurality of members, spaced apart one from the other and secured to heads with bands encircling the same throughout the majority of the circumference, thereby increasing the strength, rigidity and durability of the structure.

RURAL LETTER CARRIER'S ALL METAL CABINET.—WILLIAM T. SWIRE, Tannelton, Ind. This invention is an improvement in rural letter carriers' all metal cabinets, and is shown in perspective in open position in the illustration. The mail box is shown as separated into a plurality of compartments by a transverse partition and by partitions at right angles. A rod holds the box in horizontal position and the toggle levers are of such length that they are aligned when the box is in this position. The arms act in the manner and, in fact, are springs to lift the lid or cover. The pocket is designed for letters, while the compartments are for papers and packages. In normal position the box is supported on a dash board and floor of the carrier's wagon. The box is preferably of galvanized material and may be of any desired size.



RURAL LETTER CARRIER'S ALL METAL CABINET

MANUFACTURE OF SCREENS FOR USE IN COLOR PHOTOGRAPHY.—L. DU HAURON and R. DE BERCEGOL, 17 Avenue Pauline, Joinville-le-Pont, Seine, France. The object to be obtained is to cover a transparent or translucent surface, such as glass, celluloid, paper, etc., with an extremely large number of exceedingly small regular figures, e. g., bands, rectangles, lozenge-shaped figures, etc., having three distinct colors placed close together without any interval, and each of which theoretically should, altogether, cover a third of the surface.

CLEANER FOR CHALK ERASERS.—J. A. JOHNS, 321 W 10th Street, Anderson, Ind. In this instance the invention is an improved apparatus for use in removing chalk dust from blackboard erasers, and in which the inventor employs with it rough and fine pencil-sharpeners which are operated by the same shaft and the same motor as the chalk-eraser.

FOLDING SCAFFOLD.—E. ZANN, Rhodesia Park, Norwalk, Conn. This invention has reference to folding scaffolds for general use, his more particular purpose being the provision of a simple, strong and efficient scaffold suitable upon the exterior faces of building walls and adapted to be set out and drawn in through windows and the like.

SUCTION APPARATUS.—A. SAUER, care of Sauer Power Generating Company, 5115 Rosetto Street, Pittsburgh, Pa. This invention provides a suction or vacuum apparatus, for heating, ventilating, refrigerating and other purposes. Use is made of a suction chamber provided with an annular passage connected with a steam supply and from which lead a number of spiral passages into the suction chamber to produce a vortex blast in the suction chamber.

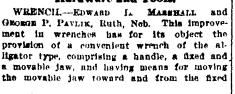
LENS MOUNTING.—G. LOWENSTEIN, 668 Park Place, Brooklyn, N. Y. This invention relates more particularly to mountings, in connection with spectacles and eyeglasses, the special purpose being to produce a device in which the lens is readily detachable from the framework normally supporting it, and yet when held in position by the framework the lens is secured with a proper degree of firmness.

WRITING POSITION AND MOTION TRAINING CARD.—J. L. MONTGOMERY, 259 Rich Avenue, Mount Vernon, N. Y. This improvement provides a card named with openings or stencil forms arranged to control the movement of an inscribing pencil; and to form a paper guide and paper rest to control and facilitate the formation of the marks, the repetition whereof, it is found, trains the hand and arm of the students of chirography.

SAFETY RAZOR.—E. P. MCCOLLOM, 810 North Avenue W., Alleghany, Pa. The improvement is in that type of safety razors in which a reversible blade is secured detachably upon the toothed head or guard, and more particularly in such sub-type as includes a spring handle having the extremities so constructed that they are adapted to enter notches or open slots in the blade, and thus serve as a means for operating the latter.

Hardware and Tools.

WRENCH.—EDWARD J. MARSHALL and GEORGE P. PAVLIK, Ruth, Neb. This improvement in wrenches has for its object the provision of a convenient wrench of the alligator type, comprising a handle, a fixed and a movable jaw, and having means for moving the latter jaw toward and from the fixed



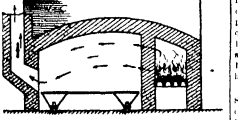
WRENCH

jaw, and for locking it, in adjusted position. As shown in the illustration, the corner plate of the wrench is removed. The lower jaw is fixed and the upper movable jaw is provided at its inner end with an enlargement filling the recess. At the center of the recess the jaw is perforated and counterbored around the opening to secure the hub. The wrench is simple and compact, and the parts are easily assembled.

FOLDING BRACE.—F. D. TURNER, Box 84 Woods Cross, Utah, and N. DEE CORNIA, Salt Lake City, Utah. It is well known that one of the most inconvenient tools to pack away is the ordinary carpenter's brace. An object of the invention is to provide a device which is capable of being folded up into a compact form so as to occupy little room in a tool chest or carrier, and which can be easily adjusted to the proper working position.

Heating and Lighting.

GARBAGE CREMATORY.—RALPH E. NYE, Hobart, Okla. In this case the invention is an improvement in furnaces for use in incinerating garbage and has for its object to provide a novel construction in which garbage and the like may be readily moved into the incinerating chamber on a car adapted for



GARBAGE CREMATORY

the purpose and may be effectively dried and burned. The walls of the apparatus may be of brick or other suitable material. A vertical cross section of the apparatus is shown in the accompanying drawing. The apparatus may be used for cremating dead animals and for consuming garbage excrement, manure and other obnoxious filth requiring intense heat.

Machines and Mechanical Devices.

MACHINE FOR CONVERTING PULP INTO SHEETS.—H. G. HOGGINS, Au Sable Forks, N. Y. This wet machine forms paper or other pulp into sheets, and delivers the same in a partially dry state. It has an increased capacity over machines of the same general type, and in which the sheets are delivered with a relatively small amount of moisture and in uniform lengths and widths and without the use of knives, pins or shears and without substantial waste of the pulp.

PLYING MACHINE.—C. F. KOHLERUS, Washington and Ellis Streets, Augusta, Ga. In this machine the weight is in the center range of the supporting surface, and below the same thereby greatly increasing the stability and lessening the liability of upsetting by unexpected gusts of wind. In case the motor or motors should stop the planes would permit the machine to settle down gradually to the earth in the manner of a parachute.

MACHINE FOR REMOVING WASTE GILDING.—R. J. CAMPBELL, Jr., R. M. SCANLAN, and W. BRADY, 10 May Street, New Rochelle, N. Y. The invention refers to a machine for removing the excess gilding material from a cover after lettering or figuring has been impressed thereon, and to escape off the waste without danger of injuring the covering. It provides a rotary buffing member with a movable table adapted to adjust the work into and out of engagement with the buffer, and with means for adjusting the position of the table.

ESCAPE VALVE.—J. D. BROWER, Jr., Palodic Grove, Cal. This invention relates to valves for use in connection with water mains and the like, to permit the escape of gas or air from the main when the water or other fluid is allowed to enter the same, and relates more particularly to a device of this class comprising a main valve adapted to control the escape of gas or air from the main, and an auxiliary valve controlling the main valve, and itself operable by the liquid in the main or conduit.

PLUMBING VALVE.—H. B. GILSON, care of Ambridge Savings Trust Co., Beaver, Pa. In the present patent the purpose of the invention is the provision of a cheap and efficient flushing valve which will operate with any water pressure, and which may be adjusted from without to control the flow of water to meet the requirements, although the water pressure may be greater or less than normal.

VENDING MACHINE.—E. L. ROBINSON, Fire Station No. 2, Topeka, Kan. The object here is to provide a device which upon the insertion of a coin of the proper denomination, will deliver a measured quantity of unshelled nuts into a shelling device and thence into a bag, which has been taken from a pile of the same and held in the proper position by mechanism actuated by the same coin.

BLUE PRINT WASHING AND DRYING MACHINE.—O. HOOPS, 560 Park Avenue, care of Bldg. Bureau, New York, N. Y. The aim in this invention is to provide a machine having two endless belts, having sprocket openings at their sides, which are disposed against each other, and which run over rollers with sprocket teeth journaled in a casing containing tanks and a compartment for respectively washing and drying the blue prints. The last are conveyed down the belts through the machine, and are introduced and removed at points outside the casing where the belts are spaced from each other.

AIRSHIP.—C. V. JOHNSON, Box 1396 Goldfield, Nev. An object of the improvement is to produce an air ship having a construction rendering it easily manageable, having improved means for maintaining its equilibrium and for directing the course of the air ship. A further object is to provide an arrangement whereby the air ship can float and be propelled in water in case it should alight upon that medium.

MEANS FOR THE PROPULSION OF AUTOMOBILE TORPEDOES.—ANDREW E. JONAS, Picard Agent, Plume, Austria Hungary. The object here is a means of propulsion specially adapted for obviating numerous defects, at the same time diminishing the friction due to the passage of the shafts through stuffing boxes. This is obtained by arranging the axes of the motor cylinders of the group in planes parallel with the longitudinal axis of the torpedo and below the axis of propulsion, in the direction of running, and also of increasing the stability of the torpedo by lowering its center of gravity. This construction allows of connecting rods and crossheads of normal length. Means provide a hermetic sealing of all the parts.

PUMP.—E. J. HARPER, Jr., 522 W. 161st Street, New York, N. Y. Among the principal objects which the present invention has in view are: To provide means for counteracting the swirling of the water within the barrel of a pump and in the delivery column thereof, and to provide in a rotary pump devices for correcting the swirling of the water as it is being delivered from the various blades or fins.

SEWING MACHINE ATTACHMENT.—D. WARD, O. C. BRITSCH and M. FERGMAN, New York, N. Y. The object here is to provide an attachment for sewing machines whereby the motor, and controller therefor will be in an unexposed, unobtrusive position, and wherein either or both the motor and controller can be readily detached for the purpose of renewing or exchanging.

VENDING MACHINE.—C. H. SCOFIELD, Cherry Valley, N. Y. An object of this invention is to provide a coin-controlled means for automatically delivering an allotted quantity of peanuts. Further to provide a means for automatically supplying a bag or other receptacle to the purchaser, and also to provide means for keeping peanuts or other articles stored in the machine, at a suitable warm temperature.

THROTTLING DEVICE FOR MARINE ENGINES.—O. J. MCGOWAN, New York, N. Y. This improvement provides means for shutting off the steam supply of an engine when a seagoing vessel is lifted by the waves to the position commonly called pitching, provides a racking valve operable by the swing of the hull of the vessel relative to a constant vertical member, and provides a mechanism for throttling the steam supply main of a marine engine.

FLYING MACHINE.—L. C. KINCANNON, Scarbrough, Cal. This invention is an improvement in machines of the character disclosed in Letters Patent formerly granted to Mr. Kincannon the machine embodying in its construction a number of rotary carriers each having wings or vanes arranged about its axis and which are intermittently revolved to present the upwardly moving vanes or wings vertically and the downwardly-moving vanes or wings horizontally.

CONCRETE WALL MOLDING DEVICE.—R. W. FULLER, R. F. D. No. 2, Selling, Okla. An object of this invention is to provide a device comprising movable side members forming parts of a mold, said members being so arranged that they may be securely fastened together when the form is being molded, and can be removed laterally from the wall when it is desired to remove the mold.

AEROPLANE.—R. P. HALL, Searchlight, Nev. This invention provides a machine with lifting capacity to support the weight of its load and a limited amount of freight or number of passengers, provides means for steering the machine vertically and horizontally, provides means for automatically balancing and maintaining the lateral stability, and provides a parachute attachment for landing in the event of damage to propelling means and supporting surface of the machine.

Prime Movers and Their Accessories.

INTERNAL COMBUSTION ENGINE.—I. F. FRIEND, 17 Stat. Street, Norwalk, Ohio. The object of the invention is to provide an engine having an arrangement of parts such as will secure the maximum horse-power with the minimum consumption of fuel. Further, to secure a perfect mixing of the charge so as to secure the utmost efficiency from the fuel. Further, to prevent the overheating of the engine.

STARTING BURNER.—H. W. GARDNER, care of Farmers' & Merchants' Bank, Springfield, Mo. This invention comprehends a burner of rather simple construction having its various parts suitably arranged, whereby oil in a liquid form and air under pressure are admitted directly into the burner, the air in making its escape serving to atomize the oil and thus form with it a combustible mixture.

Railways and Their Accessories.

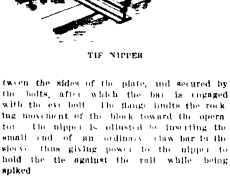
TRACK RAIL.—J. G. MOORE, care of P. S. JENNINGS, 90 West Street, New York, N. Y. For the purpose of preventing accidental unscrewing of the nut it is made in sections and the opposite faces of the sections are provided with saw surfaces for pressing the sections away from one another against the threads of the bolts to lock the nut in place at any desired point along the bolt and means for locking the nuts and bolts together to prevent the same from turning.

CROSS TIE.—W. L. JONES, Chase Mills, N. Y. This invention relates to cross ties for use with railroad track rails and the like and has reference more particularly to a cross tie which comprises a body and rail supporting means at each end thereof mounted to swing into and out of normal positions and having a limited movement longitudinally of the body, this movement serving to raise or lower the rail-supporting elements.

CAR STEP REGISTER.—R. M. BAUCH and L. R. BAUCH, Neillsville, Wis. This invention comprehends a number of steps provided with depressible platforms there being two narrow steps to each rail support ing means at each end thereof mounted to swing into and out of normal positions and having a limited movement longitudinally of the body, this movement serving to raise or lower the rail-supporting elements.

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TIE NIPPER.—WILLIAM A. SCOTT, Consul, Ala. This device is to be united beneath the rail by a perpendicular slot and placed for operation. In this operation the block forms a fulcrum for the bar, and the bill may be lengthened or shortened to suit condition. The device is assembled by first passing the eye bolt through the slot with the threaded end pin in place. The block may then be placed be-



TIE NIPPER

tween the sides of the plate, and secured by the bolts, after which the bill is engaged with the eye bolt. The dangling knuckle rock ing movement of the block toward the opera tor. The nipper is effected by inserting the small end of the bill in the slot in the sleeve, thus giving power to the nipper to hold the tie against the rail while being spiked.

Pertaining to Vehicles.

PERCUSSION MECHANISM FOR AUTOMOBILE TORPEDOES.—A. F. BOOKS, 2 Via Volosca, Fiume, Austria Hungary. The object here is the improvement in the percussion mechanism of automobile torpedoes in which the striker is constituted by the inertial reaction by a lever connected with a releasing member acting by inertia and it has particularly in view to improve the conditions under which the mechanism operates and the certainty of its operation.

NOTE.—Copies of any of these patents will be furnished by the Scientific American for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.



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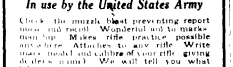


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(12558) R A S says: 1 What is the temperature at which glass and quartz melt? A. Glass gradually softens as it is heated until further heating produces no further change. It does not become a freely flowing fluid at any temperature, but only a thick, viscid substance which flows like cold molasses. Different kinds of glass begin to soften at widely different temperatures. Any glass may be heated probably 400 deg to 600 deg F without becoming soft. Quartz is melted only by the electric arc, which has a temperature above 6,900 deg F. 2. What is the temperature at which mercury vaporizes? A. Mercury boils at 674.6 deg F. 3. What is the average amperage per cell of a storage battery when fully charged? A. The number of ampere hours of a battery is usually given by the surface or weight of plates. It differs for different makes of battery and rate of full charge and size of cell. A storage battery in a certain electric light station gave this report: 156 cells, 25 positive and 25 negative plates each, at 10 hour discharge rate gave 278 horse power per hour, average volts 1.9 per cell, 204 pounds per horse-power hour. At one hour discharge rate, it gave 1,120 horse-power average volts, 1.8 per cell 500 pounds per horse-power hour. As a rule lead cells has been given .53 ounces lead peroxide for a 10 hour discharge rate, increasing to 1 ounce for 1 hour discharge rate. Ask makers of any particular form of cell will give figures of its performance upon application. 4. What is the formula for finding the wattage of a direct current generator? A. The volts given by a dynamo are determined by the rate at which the lines of force in the field are cut by the coils of the armature, and the amperes by the resistance of the dynamo as a whole. The watts are the product of the volts and amperes. These quantities are measured by the instruments in the test of a machine. In designing they are assumed, and the machine is built to give its rated output. The size of wire to be used are selected to carry the amperes without heating above the safe limit. 5. Will the color of the tube in a mercury vapor lamp have any effect on the light? What is the best color for ordinary lighting purposes? A. The color of the tube in the mercury vapor lamp will modify the light by absorption. The color to which our eyes are accustomed is that given by the sun as light containing all the wave lengths from red to violet. 6. In a mercury arc in a vessel the size of a 50 ampere tungsten, what amperage will vaporize enough mercury to break the built at 110 volts? The pressure of gas or vapor which will break down the bulb varies with the kind and thickness of the glass. No numerical answer can be given to the question as you put it.

(12559) H C says: 1 What is meant by the center of the force of gravity and where is this point situated in the earth? It would seem that if the pull of gravity is toward the center mass at the center of the earth the pull will be outward in every direction, and consequently the earth hollow. A. The center of the force of gravity upon any body is the point in the body about which the whole body is balanced. In a uniform sphere it is at the center of the sphere. It is what we call the center of gravity. All the matter in the earth gravitates toward that point, all attraction is inward toward that point, not outward from that point. If a ball could be dropped upon the earth and move into and through the material of the earth it would drop to the center of gravity of the earth. 2. How is it proved that a plumb bob is deflected from plumb by a mass, such as a range of mountains? A. It is proved that the plumb line is drawn out of the vertical by a heavy mass such as a range of mountains, by means of an engineer's instrument for determining a level line and a vertical line. An engineer's transit is such an instrument but much more accurate instruments are used by astronomers in solving this very difficult problem. When an object is vertical the plumb line is parallel to the direction of the plumb line was seen and measured. It has been done a sufficient number of times that we may rely upon the results obtained by astronomers.

(12560) C C asks: A newspaper recently gave the velocity of electricity 304,-227,000 miles per second and of light, 328,-038,800 miles per second. That has given rise to a good deal of discussion among draftsmen and estimators employed here. You would earn the gratitude of some forty or fifty of the young men interested if you would state whether or not the velocities given are correct, and if not what the correct figures are. A. The trouble with the figures which you quote for the velocity of electricity and of light is that electricity cannot be said to have any velocity, and the velocity of light is not known with a limit of exactness of 100 yards per second. The latest determination of the velocity of light by Prof Michelson of the University of Chicago is 299,860 kilometers per second, with a possible error of 30 kilometers per second. This in miles per second is 186,330, with a possible error of about 20 miles. The velocity of the electric current varies with the conditions under which it flows. Electric waves in wireless telegraphy move with the same velocity as light.

NEW BOOKS, ETC.

ELEMENTS OF THE DIFFERENTIAL AND INTEGRAL CALCULUS. By William Anthony Granville, Ph.D. With the editorial co-operation of Percy F. Smith, Ph.D. New York. Ginn & Co, 1911. 8vo.; 463 pp, illustrated. Price, $2 50

This is the revised edition of a work already well and favorably known. The fundamental characteristics of the original work have been retained; but the past few years have marked an advance in the methods of presenting to students the elements of the calculus, and these progressive methods, after triumphantly surviving the proving-ground of the classroom, have been incorporated into the revised drill book. The authors strive to make each step intuitionally as well as analytically evident to the student, and to this end graphics have been liberally employed. There are biographical sketches of the celebrities connected with the history of the calculus, and many examples and problems designed to test the quality of the knowledge at command, and to lead on to a well grounded understanding. Whether preparing classes for elementary work in applied science, or qualifying them for the more advanced problems of pure mathematics, the teacher has here a wealth of well-arranged material from which to select his lessons and develop his theorems.

THE TEACHING OF GEOMETRY. By David Eugene Smith. New York: Ginn & Co, 1911. 12mo, 339 pp, illustrated Price, $1 25

Geometry has been the object of many attacks which question the expediency of its inclusion in the mathematical curriculum. It has been condemned as removed from the real problems of human activity, taking up time that might better be devoted to some more practical branch of mathematics. The author, who is a professor of Teachers College, Columbia University, admits the obsolete character of certain portions of the old geometry, and is too fair-minded to attempt a justification of the study as being utilitarian in any narrow sense, yet his chapter, "Why Geometry Is Studied" puts forward some timely and pertinent considerations. Without siding on the one hand with those who would radically alter the body of matter now presented to students, or on the other hand with those who are blindly content with the system as it now stands, Prof Smith believes in a gradual progression toward more modern methods of treatment, and his papers are frankly addressed to those progressive yet well poised teachers who are striving to invest the subject with vitality and appeal. His purpose is commendable, his ideas well-conceived, and his plans admirably developed in the attractive volume before us.

EVOLUTION. By Patrick Geddes and J. Arthur Thomson. New York: Henry Holt & Co 1911 12mo; 256 pp. Price, 75 cents net

Taking the evolution theories as the canvas for their picture, the authors unroll before us, with the effect of panoramic distances, long perspectives and shifting skies, what they have striven to make "a rational vision of world-development." They show us that in spite of the variations of age, sex, origin, grouplings, and occupation every generation has much more in common than its individuals realise. They develop the theme of unity in diversity, of order in the midst of change, until there grows within us a clear conception of the nature of this continuous progression—of this organic and inorganic individual and social mode to which we give the name Evolution. Recent research stimulated by Darwin made the world almost blind for a time to the pregnant potentials of the social perspective in its application to evolution. The authors avoid the mistake of forced interpretation may meet and merge into a clear focused projection of the universal development.

SPICES. Their Histories. By Robert O. Fielding. Seattle, Washington: The Trade Register, Inc. 1910. 16mo.; 61 pp., illustrated. Price, 50 cents.

"Spices" is a reprint in booklet form of several articles originally published in the *Trade Register*. Its information is particularly directed toward retail grocers, and is alphabetically arranged under the various spices-names, each section consisting of a description of the variety, its manner of growth, and its chief uses, with an occasional caution as to the substitutes of the market.

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Correspondence

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How Russia Plans to Build Up Her Merchant Marine

To the Editor of SCIENTIFIC AMERICAN:

Perhaps no other nation on the face of the earth approaches the United States so closely as does Russia in the basic economic conditions governing the general trend of development of the national industries. Both countries are at present facing a crop of strikingly similar industrial problems of grave moment, arising directly out of the policy of protectionism *per se*. Conspicuous among them looms up the problem of a national merchant marine, which formed the subject of thorough-going study and foreign investigations by agents of the Department of Trade and Manufactures, as well as of repeated turbulent discussions in the national Duma.

The entire session of the Council of Ministers of August 4th was devoted to dissecting various phases of this problem Legislative measures were laid before the Council, and commercial aspects discussed, looking to the encouragement of national shipbuilding on the one side, promulgation of a foreign merchant marine on the other, and of the Russian export trade in general.

One question was settled with not a dissenting voice, namely, that the idea of promoting national shipbuilding by imposing prohibitory or even discriminating duties on foreign built ships should be discarded. Like the United States, Russia is at present building enough ships for the coastwise traffic and the internal seas and waterways (*Cabotage*), but Russian-built ships cannot even dare venture into competition with foreign-built vessels outside of the tariff-shielded Russian domains. And precisely like the United States, Russia must have a merchant marine, if it were but to insure the future of the Russian navy The two phases of the problem were dealt with separately, and two distinct solutions were finally arrived at by the Council, viz.:

Free Ships—To stimulate Russian foreign navigation and to promote the Russian export trade, saving hundreds of millions annually on carrying freight, passengers, and mails

Differential Subsidies—To aid the handicapped Russian shipbuilders to the extent of equalizing as nearly as possible the cost of building them at home and abroad

Foreign-built ships are to be admitted into Russia free of duty until January 1st, 1913, pending further legislation On the other hand, two separate scales of differential subsidies were adopted, in proportion to tonnage, for home-built merchant vessels, which are to navigate the foreign seas, as well as the river Danube and its tributaries. The first scale relates to iron steamships, the other provides for iron sailing vessels, including the so-called auxiliary craft

The subsidies for the first category range from 105 to 65 roubles per ton of gross capacity. Ships of the second category are subsidized to the extent of 84 to 52 roubles per gross ton In certain specified instances the schedules are modified in reverse proportion to tonnage. Over and above the tonnage subsidies, special subsidies are provided for motive power—whether principal or auxiliary—to the extent of 35 roubles per horse-power indicated. Further subsidies are to be granted for overhauling and installation of new boilers and machinery, at the rate of 1 R. 50 Kps. per pood (36 pounds) for the boilers, and 5 R. 50 Kps per pood for machinery.

This subsidizing of home shipbuilding is tentatively fixed for the period of fifteen years. The rate of subsidies will remain stationary during the first seven years, whereupon they will be reduced annually by 6 per cent.

With the view of obviating the possible artifices on the part of shrewd foreign shipbuilders, contriving to utilise Russian subsidies to their own advantage, a time limit of three years of Russian service from date of registration of the ship had been fixed. If the ownership of the vessel should be transferred abroad prior to the expiration of this time limit, any subsidies received from the Russian government for construction or overhauling must be refunded in full to the exchequer.

In this way Russia plans to stimulate her export trade, foreign merchant navigation under her flag, and shipbuilding at home. It won't be long before the effect of these measures will become manifest, for the official encouragement in either direction provides sufficiently weighty inducements to promote immediate activity in the field contemplated

We need not expatiate on the immediate trade-booming effect that the upbuilding of direct shipping between Russia and the United States is bound to produce The American exports to Russia will go up by leaps and bounds.

In fact, they are going up already, owing solely to the development of Russian steamship traffic from Baltic to American ports. Russia imports over $50,000,000 worth of raw American cotton alone, all of which practically has been handled by the British shipping up to the current year The establishing of direct steamship service to the Baltic ports has resulted forthwith in a loss to the British shipping trade, amounting to $1,508,000 in the first five months of the current year, and a substantial decline in the volume of the British exports to Russia For the first time in the history of the American foreign trade, the United States has dispossessed England of her second place among importers to Russia, next to Germany. The British exports to Russia fell off from $21,043,627 in the first five months of 1910 to $24,423,990 for the corresponding period of this year. (This including even the unprecedented advance in the export of woolen yarns, which attained $1,500,000.) In the same time, the exports of the United States rose from $21,043,627 in January to May, 1910, to $28,297,237, respectively, in 1911. *An increase of almost 35 per cent.*

The exports in agricultural machinery went up from $4,867,000 to $8,760,000 (an increase of 80 per cent), other American specialties, from $1,217,000 to $2,920,000 Raw cotton went up to $16,646,000, an increase of $1,703,000

These figures are so strikingly decisive and pointed as to stand in no need of any elucidating comment.

New York, N. Y. ED. *R. A. M.*

The Merchant Marine Problem

To the Editor of SCIENTIFIC AMERICAN:

Having read your articles on shipping in the special number of the SCIENTIFIC AMERICAN, I feel prompted to bring to your attention a phase of the question not touched upon—the crews.

I will say at the outset that I was originally a "subsidy" advocate, and would not denounce some forms of that scheme yet, in fact would at the time have accepted the bill presented by the late Senator Hanna, in spite of its abuses

I fully believe a system of subsidies (make it mail subvention, naval reserve subvention, or what you would) would result in an increase in mercantile marine, as witness the German flotilla in which the German government guarantees a dividend of 7 per cent to the North German Lloyd Company, thus enabling it to operate at cost. (Hon. William Bill Sulzer kindly note this.)

So much exaggeration has been made of the evil results of a subsidy scheme, though, that it is useless to try it any longer; further, if we resort to discriminating duties, we must remember that two can play at that game.

The one scheme left is to admit foreign-built vessels (of course, only to be engaged in foreign trade). This would be a good idea, but taken by itself would result in nothing if we did not also admit their crews

For purpose of illustration, compare a vessel of the same size in four other prominent marine nations with one of ours, for instance, American steamer

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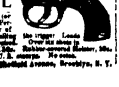
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This may not look so formidable a foe for the American, but the wages of the entire crew of the American boat amount to $16,620 a year its nearest competitor, the British vessel, costing but $10,220 per annum, while the total wages on the Norwegian boat amount to but $6,128 per annum. Under the Hanna bill the "Cherokee" could have earned something between $10,000 and $12,000 per annum, if kept constantly in business; this would have made her capable of competing against even the Norwegian boat.

Suppose we cut the crews of foreign-going American vessels down to the force required of their competitors. Will they work for the same wages or eat the same food the foreigners put up with? The only way I can see to overcome the difficulty is to allow free registry of boat, crew and pantry, and even "load water line," an arrangement which allows boats of some nationalities to take in more cargo than those of other countries.

Another stumbling block is the insurance. We had quite a bit of information about the great influx of American "clippers" on the British registry when that government granted them permission, but so far as I can find there appears to have been only some 20,000 tons of such vessels that changed flags when the British insurance companies came to the rescue of the British shipbuilders and refused to insure either ship or cargo unless the ship were built according to their specifications and under the supervision of one of their agents.

Let us stop scrapping among ourselves and do something, if only to a certain limit. I can see no reason why we should not, for instance, admit to registry "for foreign trade only" all vessels of which a majority of the stock was owned by American citizens on the 1st day of July just past and allow them to have the same officers and crews and standard of feeding as they were required to have under their present flag.

BUSHROD M. GORDON

Washington, D. C.

The Role of the Cruiser Dreadnought

To the Editor of SCIENTIFIC AMERICAN:

In your issue of October 14th, a letter from Mr. A. B. Irwine brings up the oft-mooted question of battle cruisers, and suggests that the United States construct some of this type immediately or be hopelessly handicapped in a modern naval engagement.

The point at once arises as to whether these 30-knot eight-gun cruisers are to be used only as scouts, as your correspondent seems to think. Ten million dollars is a lot of money to pay for a scout, and to my mind scouting was not the primary purpose of these vessels. The Russo-Japanese war and battle conditions in our own navy have shown that swift 25-knot destroyers with a wide cruising radius are best adapted for scouting, being less easily seen and almost impossible of pursuit. The question of commerce destroying has also been considered, but the presence of a couple of wicked looking destroyers will bring down the flag of a merchantman as quickly as a cruiser dreadnought.

These vessels are being built by Great Britain, Germany, and Japan, *not as a substitute* for dreadnoughts, but *an addition* to the regular programme, their chief work being to operate together in a flying squadron, capping the enemy's column, throwing it into confusion, if possible, and then retiring, leaving the heavy work to the dreadnoughts.

It is well known that these powerful-looking cruiser dreadnoughts can not stand closer in battle than 10,000 yards to a column of the *same number* of pre-dreadnought battleships such as our "Connecticut" class, on account of their thin armor.

As long as we possess high-speed destroyers equipped with wireless, we need have no fear of not locating the enemy; the disadvantage would appear when the battle was under way. Of course it would be very nice for the United States to have these cruiser dreadnoughts, say one each year, but it would also be nice if we could have more destroyers and the proper number of colliers and other auxiliaries. It is simply a question of money, and being limited in this, it would be folly for the Navy Department to follow any other but its present plan of constructing two super-dreadnoughts a year, equal in power to the latest foreign ships. We will shortly slip back to third place in the naval ranking, and now even this very conservative programme is in danger. No one would think of comparing the cruiser dreadnoughts with our "Washingtons" or "Chesters." We might as well compare the "Oregon" with the "Neptune" of the British navy.

But owing to financial limitations, this type and many other necessary accessories to our battle line will be missing from our building programs for some time to come.

HAROLD M. KENNARD.

Brooklyn, N. Y.

The Pumps Used in Uncovering the "Maine"

IN our issue of September 2nd we published an article on the uncovering of the "Maine." No small share of the credit of the work accomplished is ascribable to the special pumps employed in the performance of the task. These were of the type technically known as the Jeanesville double-suction split-casing pump.

In the double-suction pump, the incoming fluid enters on both sides of the impeller and discharges from the impeller into a common vortex chamber. This double suction construction gives a perfect rotative balance and eliminates all difficulty encountered from end thrust, which is so troublesome in pumps of other designs.

The casings and bushing boxes are split horizontally, which permits of ready access to all interior parts of the machine. The design is such as to accomplish this without breaking any pipe joints or other connections and without disturbing the shafting, or deranging the alignment of the pump and prime mover.

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These features are of the greatest importance in operations where the conditions are so severe as those encountered in the work of raising the "Maine" and others, on account of the constant liability of various solid and semi-solid objects and materials entering and clogging up the pumps. It is necessary easily and quickly to reach and examine all interior parts of them.

The Current Supplement

THE question whether other orbs beside our own earth might be inhabited by living creatures is one which appeals to the imagination with peculiar interest. A scientific discussion of the conditions on different celestial spheres with this question in view is given by H. C. Wilson in the current SUPPLEMENT.—A new type of continuously working filter press which is described, should prove of interest to those engaged in industrial operations.—Liquid fuel is now being used in the production of steel. An illustrated article deals with this subject.—Mr. A. C. Rateau writes on the subject of turbines in warships.—We have all heard of the importance of proper mastication of food as a necessary step for a complete and healthy digestion. There are, however, other reasons why thorough mastication is essential to the general health of the individual. This subject is discussed very lucidly in an article derived from the *Dominion Dental Journal*.—An article illustrated with very fine views of the historic Sea of Galilee is contributed by Harold J. Shepstone.—Our Paris correspondent writes on the future of the aeroplane in army service.—An interest-



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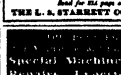


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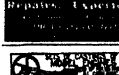
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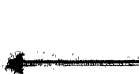
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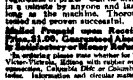
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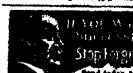
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ing and promising new departure in the field of automatic aeroplane control is the Doutre stabiliser, which is described somewhat in detail.—Some years ago attention was drawn, principally by Gayley, to the advantages obtainable by drying the air used for blast furnaces. Two writers in recent French publications describe a method of drying the air with calcium chloride which offers certain advantages over Gayley's method. An abstract translation of these articles appears in our current issue—Dr J A Harker of the National Physical Laboratory, Teddington, England, gives a most instructive review of recent advance in high temperature measurement.

Phosphates in the Pacific

IT was thought a few years ago that all the phosphate and guano beds of the Pacific Islands, after yielding millions of dollars worth of fertilizers, were at length exhausted This view has been changed by the discoveries made since 1907

The largest phosphate industry that the Pacific ever saw is now in progress on two neighboring islands, the German island of Nauru, the most southern atoll of the Marshall group, and the British island of Banaba Hundreds of islanders as well as Chinese and Japanese laborers are working in these phosphate diggings, and though the industry is still very young, it is yielding over 2,000 tons of prepared phosphate a year. The yield is increasing as fast as improvements are made in mining the rock and in facilities for shipping it

The beds in the two islands seem to be similar in the quality of the rock, and though their thickness has not yet been ascertained the quantity of phosphates is enormous Numerous borings have been made all over Nauru, which comprises about 5,000 acres These borings were not meant to ascertain the total phosphate content, but merely to determine if there was enough of the rock to pay for the erection of expensive works

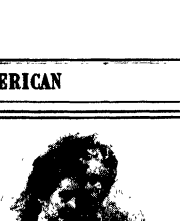
They were sunk, therefore, only to a depth of ten to fifteen feet The Germans report that under the superficial earth the entire 5,000 acres are covered with phosphate beds to a depth of at least ten or fifteen feet, and they do not know how much deeper the beds may go, for they have not explored lower levels

They add that it will take some generations to remove the phosphates already revealed. The two companies, German and British, that secured concessions to mine the rock, have joined their interests and are working together. The outside public has nothing to do with their enterprise except to buy the product

When the German flag was raised over Nauru, twenty five years ago, the 1,500 natives had no relations with the whites except to sell their cocoanuts for brandy and wretched firearms supplied by two or three unscrupulous traders The Germans stopped this trade, but it was long before the real wealth of the little island was discovered.

Now a great transformation has come Large steel framed buildings in which the rock is prepared for commerce have been erected, an iron pier has been extended out into the sea beyond the breakers, and lines of steel tracks lead down from the mines to the piers. But the rock is as yet taken out to the anchored steamships in small boats and the Germans have little hope of discarding this primitive method They say the surf runs too high for ships to tie up at the landing wharf

Influence of Chewing on the Condition of the Teeth.—Investigations on the children in the town of Kötzing in Bavaria showed that of those who eat hard bread the percentage with bad teeth was 6 9, of those who eat both hard and soft bread, 8.2; of those eating only soft bread, 10 5 In the town of Ibringon (Baden) the percentages before and after the introduction of soft bread were as follows: In 1894, when only hard bread was eaten, 12.4 per cent; in 1897, just after soft bread had been introduced, 12.9 per cent; and in 1901, where most of the bread consumed was soft, 20.9 per cent.



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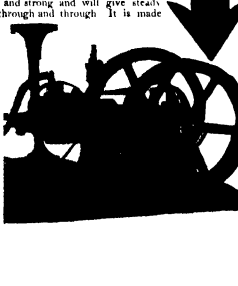
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NAVAL NUMBER

DECEMBER MAGAZINE NUMBER *of the* SCIENTIFIC AMERICAN ISSUE OF DECEMBER 9th, 1911

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Hon. G. von L. MEYER — Secretary of the Navy — "The Business Management of the Navy"

Rear-Admiral ALFRED T. MAHAN, U. S. N. — "The Command of the Sea"

Rear-Admiral RICHARD WAINWRIGHT, U. S. N. — Aide For Operations of the Fleet — "The Fleet and Its Readiness for Service"

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Rear-Admiral N. C. TWINING, U. S. N. — Chief of the Bureau of Ordnance — "Recent Developments in Ordnance"

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Colored Cover by H. REUTERDAHL — PHOTOGRAVURE INSERT

Illustrated by Photographs Taken During the Late Autumn Maneuvers

The period of American history which opened with the Spanish war will always be reckoned as one of the most momentous in the growth of the United States. Then it was that this Republic moved forward into its present commanding position as one of the leading nations of the world.

Two events contributed to this. First: The enormous growth of our industries, far outstripping the demands of home consumption, led to the upbuilding of our present extensive foreign trade. Second: The acquisition of Hawaii, the Philippines and our West Indian possessions, by extending our coast line into distant seas, broke down the geographical isolation of the United States and threw us into an intimate political and military relation with the whole world.

As one immediate result our Navy assumed an importance which it had never before held. The growth of our fleets since 1898 has been steady, and, until the past two or three years has been fairly well adequate to our necessities.

During the period referred to the Scientific American has lent its pages freely to the work of describing the growth of our Navy, and we believe that the intelligent interest in the Navy and its undoubted popularity have been due in no small degree to the efforts of this journal.

As a fitting climax we are in a position to announce that on December 9th we shall issue a magazine naval number, which will be written entirely by leading officials in the Navy, each of whom stands at the head of the particular branch of the service of which he treats.

No journal has ever presented an issue, dealing with naval affairs, of such value and authority as this. A perusal of the above list of writers and subjects will show that this edition will constitute a *brochure* on the Navy, written within the Navy, by its most distinguished officials.

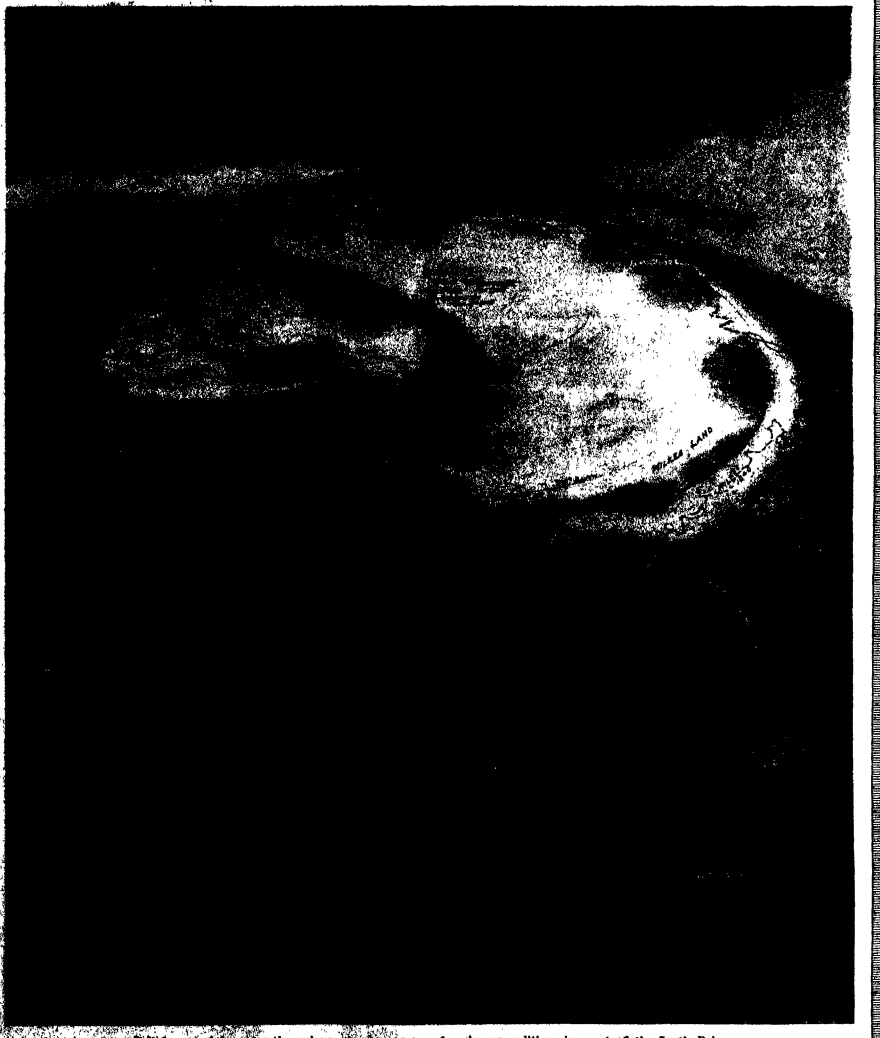
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Relief map of the Antarctic regions, showing routes of various expeditions in quest of the South Pole.

ANTARCTIC EXPEDITIONS, PAST AND PRESENT.—[See page 434.]

SCIENTIFIC AMERICAN

Founded 1845

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The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

The purpose of this journal is to record accurately, simply, and interestingly, the world's progress in scientific knowledge and industrial achievement.

Evolution and Geographical Distribution

WE generally think of the survival of the fittest as a principle which operates *in time*, bringing about those changes in biological species which are implied in the term "evolution." But the same natural selection which *in time* causes a closer adaptation of the organism to its environment is also potent in regulating the distribution of the several types and species *in space*. For, as climatic and other conditions vary according to the locality, the "selective influences" at work at each point of our globe differ correspondingly from place to place, and the material selected, the surviving type, thus becomes a function of geographical position. The white man of the temperate zones is ill adapted for the torrid climate of central Africa, where nevertheless thrives, physically at least, the dusky native. The latter, again, when transplanted to our climate, proves less fitted for the battle of life than the white race, as is shown by his greater death rate and liability to certain diseases.

But selection does not operate through death rates alone. Let us make a seeming digression, borrowing an example from physical chemistry. The chemist separates the more volatile constituents from a mixture by establishing local differences in temperature in a suitably constructed system, the hot portion is called a retort, the cold a receiver. The mixture is heated in the retort, and presently the volatile vapors pass over into the receiver, where they condense to liquid. We need stretch the meaning of the term very little to say that the volatile liquid is not "adapted" to the conditions of high temperature which prevail in the retort, and is thus "weeded out" and converted into vapor. In the cooled receiver the conditions are different. Here the liquid is stable, and can subsist indefinitely. This is not unlike what happens in the living world and with the human race. In the course of time the population of Europe has increased until, for very crowding, the struggle for existence has become much intensified, however much it may have changed in character. The opening up of a new world across the seas has furnished a vent whereby some of the surplus has been able to escape to a less populous region. And just as in the still of the chemist, the substance which passes over into the receiver is not the same in composition as the material originally introduced into the retort, but contains a greater percentage of the more volatile constituents, so we may naturally look for a more or less marked difference between the overflow from the old world which has settled on this continent, and the residue in the home countries. We should, in fact, expect that the settlers, and presumably through hereditary influence their descendants also, would represent the more "enterprising" element of the original population. And indeed, a strong spirit of enterprise is by common consent one of the most marked characteristics of the American nation. Somewhat less obvious, though none the less interesting, is a similar effect which has been observed in the old world. De Candolle in his "History of Science and Savants," illustrates by a number of very remarkable examples that the refugees, who, for holding fast to their personal convictions in the face of popular opinion, were expelled from their home countries during the troublous times of the sixteenth to the eighteenth century, have, together with their descendants, contributed over four times the normal share to the world's army of scientific men, thus bringing a rich reward to the countries which offered them shelter. The practically absolute sterility of Spain in the field of science has been attributed to the influence of the terrible Spanish Inquisition, which very effectually stifled all independent thought, and killed off every individual in whom the divine thirst for truth was clamoring to be satisfied.

It must ever be a cause of universal regret that some members of that same organization which did so much to cultivate art and learning in the middle ages should, in mistaken zeal, and with the crudity characteristic of their epoch, have dealt so little sympathy to some of those who helped to lay the foundations of modern science.

Perhaps the most extreme case of the segregation of a special type of individuals by a process of "distillation" into a locality widely differing in character from the abode of the main body of the species, is presented to us when we look at a map of the polar regions, such as appears elsewhere in this issue. Here we may follow the tracks of intrepid wanderers, who braved the hardships and perils of that barren waste of ice and snow which guards the earth's poles from the approach of inquisitive man. None but the most venturesome and skilled explorers have found their way into this pale; here is selection indeed, and every man in this territory a hero.

The Toll of Aviation: A Remedy

THE passing the other day of the century mark in the number of lives lost in aviation calls to mind the pioneers whose lives were sacrificed *needlessly* in the development of this great science. The last of these to lose his life as a result of his personal experiments was Prof. John J. Montgomery, of Santa Clara College, Cal., who was killed the 31st day of October, while trying out one of his gliders.

It is a peculiar coincidence that Prof. Montgomery, who had built and operated successful gliders before the Wrights began their experiments, and who, by releasing a following surface monoplane glider from a balloon in 1905, had enabled Daniel Maloney, the aeronaut, to make the first motorless flights of a quarter of an hour's duration, should fall to his death only a few days after Orville Wright had achieved success along these lines and had risen from the ground and remained aloft 9¾ minutes without the use of any motive power save gravity and the wind. A parallel coincidence was seen in the death of Prof. Langley just after the Wrights achieved in December, 1903, what he had striven so hard and earnestly to accomplish.

When we look back over the list of pioneers who have gone to their deaths as the result of their unconquerable desire to fly *themselves*, we deplore this unnecessary sacrifice and wonder how much more advanced we would be to-day if we still had Lilienthal, Selfridge, and Nicuport. Perchance the great German would have found ere this a way to utilize the intangible ascending currents of air as Orville Wright has just utilized a 50-mile gale and thus have set us all soaring in bird-like fashion, every man on his own home-made monoplane. Oh, that some means were found of communicating with the dead, that they might transmit to us the secrets and vast knowledge they have taken with them! How much faster the world would move forward in all the sciences and arts!

But since such is not the case, it behooves those talented men who still remain not to jeopardize their lives by taking unnecessary risks. The accident that snatched away Lieut. Selfridge came within a hair's breadth of claiming Orville Wright also, while in his recent glider experiments he has had some rather close calls. The death of Prof. Montgomery so soon after, shows that danger lurks even in a motorless machine; while Glenn Curtiss should remember Manley's miraculous escape from drowning when the Langley aeroplane was launched from a house-boat, and should not personally take even seemingly slight risks with his hydro-aeroplane.

The "Father of Aviation" in America, the late much-loved and esteemed Octave Chanute, followed the proper course when he secured alert and active young men such as Avery and Herring to do the real experimenting. The same was true of Prof. Langley, who was fortunate in securing the services of so eminent a young engineer as Charles M. Manley—a man capable of constructing both motors and aeroplanes, and of flying them when built.

If Edouard Nicuport had not dared to demonstrate personally for some officers his marvelous monoplane in a treacherous, gusty wind, he might again have produced a winner of the international speed race. The lamented Capt. Ferber is another pioneer who could not resist indulgence in the new, fascinating science. Had he studied it by proxy as did his fellow-countryman, Chanute, the aviation world would no doubt have had the benefit of his active brain for many years longer.

The Food Value of Bread

ALTHOUGH mankind has made use of bread in some form or other for several thousand years, there still remains much unknown about the food value and about the relation to digestion of this universal staff of life. An English study of the subject has just been completed, by a committee of the Local Government Board. This committee made use of much of the work done by experts of the U. S. Department of Agriculture.

The old controversy between the advocates of roller-mill flour and the defenders of stone-mill flour need never again be revived, in view of the results obtained by a scientific analysis of meals produced by the two processes. Not only do the roller-mill flours show a larger percentage of available nutricants, but the best grades of wheat—the so-called "hard wheats"—cannot be utilized at all in the old-fashioned stone mill; and the flours having the best "baking qualities" are produced by the roller mills. Roller-mill flours are also the whitest flours, which appeals to many on the esthetic side.

Notwithstanding the enthusiasm of many apostles of whole-wheat bread, the findings of the commission will rob them of some of their converts. It is found that the presence in food of bran—the outer coverings of the wheat grain—may be advantageous under special circumstances, but that in general it is an undesirable element in bread. Not only is the bran itself indigestible, but it interferes with the digestion of other nutrient factors in the food. For example, in one set of experiments it appeared that when milk was taken with whole-wheat bread three per cent less of the milk was digested than when it was taken alone, or with white bread.

The most important point, however, is not the manner in which the flour is manufactured, but the character of the wheat. That is, there is more difference between roller-mill, or stone-mill, flours from different kinds of wheat, than there is between the two different preparations from the same grain. It is at the same time in the direction of producing improved strains of wheat that the most progress has been made in recent years.

Advocates of the virtues of bran in food often recommend the mixing of a small quantity of whole-wheat flour with the white flour, in order to increase the percentage of mineral matter. The gain in salts to be obtained in this manner is, however, so slight, that a growing child would have to eat an excessive quantity of bread to derive any appreciable benefit from this method. With the mixed diet that is all but universal in civilized countries, we may well depend upon other parts of the ration to supply the additional mineral matter required by a growing child.

Contrary to very common belief, this report declares that the different effects upon the teeth produced by different kinds of bread, are altogether negligible. The possibility for standardizing flour is considered to be very slight at the present time, especially on account of the different kinds of wheat used in milling. Still, the differences between the various kinds of wheat flour on the market are not of serious importance.

That whole-wheat flours may contain substances of value—quite apart from their influence upon digestion—is believed by the committee to be a possibility worth considering, and they recommend scientific investigation upon this point as well as upon several other problems that arose in the course of the inquiry.

A New Use for Cactus

A CONSULAR report from Montevideo suggests that the people of the southwestern United States, where cactus is abundant, and often a nuisance, might follow the example of the Uruguayans and utilize this plant in making whitewash. When traveling through the rural districts of Uruguay one's attention is attracted by the fine white color of the farm buildings, even during the wet season. The whitewash is made from the sliced leaves of the common cactus, macerated in water for 24 hours. To the creamy solution thus produced lime is added. When applied to any surface, a durable pearly white appearance is produced.

Hugo de Vries

Famous for his Mutation Theory of Descent

By D. T. MacDougal, Ph.D., LL.D., Director Department of Botanical Research, Carnegie Institution of Washington

ALL students of the growth and other physical activities of plants during the past twenty years have found that any consideration of the manner by which a plant retains its rigidity, plumpness or firmness, or executes movements, inevitably brings one to know the experimental studies of Hugo de Vries, who published his first paper upon the mechanical causes of turgidity as early as 1877. A plant cell may be readily likened to a sac of living matter which holds water in its interior under a pressure which may amount to as much as 25 or 30 atmospheres, and this is possible only by reason of the impermeability of the outer wall, which is capable of undergoing a wide range of variation as to its physical properties. Outside of the living membrane of a cell is another of cellulose, and this is fully permeable. The differential behavior of the living and non-living membranes when the cell is placed in solutions of osmotically active substances, such as sugar and potassium nitrate, form the basis of the phenomena of plasmolysis and afford a clue to the conditions of turgescence within the cell. The systematic use of solutions in producing plasmolysis, and a rational interpretation of the facts, were first given by De Vries in 1877.

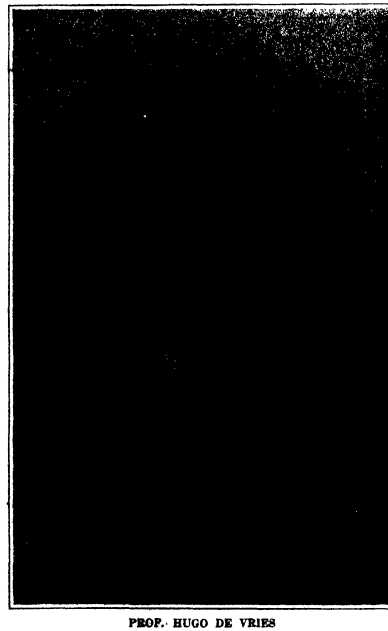
These results have their direct and immediate importance chiefly in plant physiology, but their wider application in the establishment of the isotonic co-efficients of various substances, together with the experiments of Pfeffer, another botanist, in osmosis, form the basis of the electrolytic dissociation theory of Arrhenius, as well as the law of van't Hoff that "dilute solutions obey the same law as gases," both conceptions of the greatest importance in the physics and chemistry of to-day.

With achievements of such magnitude to his credit within eight years after receiving his doctor's degree from the University of Leyden, and at the age of 29 (born in 1848, at Haarlem, Holland), the attainment of a foremost place among the botanists of the world, and the earned recognition as the greatest evolutionist after Darwin, seem a logical and natural development of a master mind in biological science.

His developing powers of research can be shown to be coincident with a movement in all natural sciences which occurred late in the last century by which attention was directed more and more to the transformations of energy in general and to the activities, functions, qualities and capacities of organisms in particular. Habits and performance were recognized as biologically more important than form or even structure. It was in consonance with this trend of science that De Vries, who had long been concerned with variability in organisms, should formulate a prothesis as to the mechanism of heredity, which should put forward a physiological rather than a morphological explanation of heredity, which was done with the presentation of his Pangenesis in 1889.

This splendid contribution was not solely an abstract product of the study, but represented the working hypothesis of a brilliant experimentalist intent on visualizing the mechanism of heredity and providing a working hypothesis by which a rational interpretation of the continuation of qualities from generation to generation through germ-cells could be made. Coincidently with its appearance, De Vries began to publish the results of his investigations upon variability, and mutations in plants, upon which he finally erected his Mutation Theory of Descent, in final and formal shape, about the beginning of this new century.

The extensive experimental cultures organized by deVries in the Botanical Garden of Amsterdam, yielded results of importance with regard to the inheritance of unusual characters in plants, such as torsions or twistings of stems, fasciations, bandings or cristations, as well as statistics upon the curves of variation of single characters. It was in these studies in the behavior of pairs in balanced characters in crossing, that De Vries rediscovered independently the Mendelian principles of alternative inheritance, which had remained unnoticed for a half century. The simplest illustration of Mendelianism is to be seen when a red and a white variety of the same species are crossed, the color qualities being considered as "balanced" or paired. The seeds from such a cross give rise to a progeny of plants all of which bear red flowers, that color being dominant over white. The seeds produced by this first generation of red-flowered individuals, however, generally produce a progeny, three-fourths of which are red-flowered while the remainder bear white flowers. Similar behavior is exhibited by many other qualities, although the division of the progeny does not always follow the simple formula noted. In addition, he brought to light many important things concerning xenia, atavism, derivation of economic races of plants, and effects of selection, of prime interest to a wide range of scientists, and to horticulturists, agriculturists and plant breeders. As may be seen, however, these results are to be considered as no more than by-products of his cultures, since much more important things were the center of attention. Early in the eighties, a series of observations were begun in which the successive generations of about a hundred species of plants were followed in order to ascertain exactly what resemblances might be found between parent and progeny in guarded and pure lines of descent. The behavior of one plant, a large evening primrose, *Oenothera Lamarckiana*, which had been introduced into Europe in the seventeenth century, offered phenomena of unusual interest, since it was seen to give rise to several sports, or salts, or mutants which differed distinctly from the ancestral form, and these new forms bore distinct qualities which were maintained in direct descent. It was upon such facts that De Vries founded his theory of the origin of new species by the sudden origination or disappearance of qualities in organisms.



PROF. HUGO DE VRIES

The biological public received these generalizations with indifference. In addition to the inertia of old ideas, some curious nationalistic prejudices found expression. As many English naturalists and scholars in other branches fought the idea of natural selection, when presented by Darwin, with vicious unfairness, so now a similar element was responsible for much criticism, resentful of anything which might modify the attitude of the world toward Darwinism, an attitude still recognizable in current publications. The writer of this note had the pleasure of presenting a summary of the mutation idea of evolution, with an account of the experimentation upon which it was based, to a meeting of botanists in the New York Botanical Garden in 1902, at which time some cultures of the *Oenotheras* from seeds furnished by Prof de Vries were begun, which, it is believed, constitute the first demonstrations of the main thesis outside of the Botanical Garden at Amsterdam. These experiments in New York confirmed the facts obtained in Amsterdam in every important particular, and their publication in 1903, found a rapidly growing interest in the subject in America. Prof de Vries was consequently invited to give a series of lectures in various institutions from the Atlantic to the Pacific, receiving a full measure of recognition in academic honors, which have been followed by similar expressions of appreciation from learned bodies all over the world.

A full, non-technical exposition of the mutation theory was given at the University of California in the summer of 1901 and to the writer fell the pleasure of putting these lectures into book form under the title of "Species and Varieties: Their Origin by Mutation." This book came to its second edition within a few months, being styled the "most notable scientific book of the year" by a competent reviewer, a statement apparently justified by the fact that it has since been translated into Dutch, French, and German.

A large number of the investigations which were begun as a result of his first visit to America profited by his second visit in 1905, and he has had the exceptional opportunity of seeing his observations repeated under the widest variety of climatic and other environmental conditions. These confirm the significance of the facts upon which the mutation theory was founded. In addition to the sports or mutants of the evening primroses which formed such an important part of the original evidence upon the subject, similar phenomena have been observed in many other seed plants and among the lower forms including the bacteria. The origination of new races or species in animals is not so easily observed, but still authenticated instances are accumulating. That new qualities suddenly appear in lines of descent is no longer a question, but it is still to be determined how large a part such action plays in the general scheme of evolutionary development.

Any discussion of Prof de Vries's work raises the question at once as to the relation of the new ideas he has formulated to the older conceptions of Darwin. One theological author has gone so far wrong as to write "The death-bed of Darwinism" by a misapprehension of the meaning of mutation. Darwin would have evolutionary progress by the selection and survival of infinitely minute divergences through thousands or hundreds of thousands of generations, arriving finally at types widely different from the original. De Vries holds that the organism fluctuates steadily about its average or norm, from which it does not depart beyond a certain limit, but the line of descent may, at any time, include individuals possessing new qualities not shown in any degree by the parental strain. Selection decides between these forms and those previously existing, the fittest of the types surviving. Instead of supplanting the theory of natural selection, the mutation conception has the actual force of coming to its support at a time when many of its generalizations were being recognized as notably inadequate to the full interpretation of known facts. The mutation theory defines more accurately the manner in which selection may act in addition to offering an explanation of the manner in which new capacities or qualities may arise.

Although now in his sixty-third year and nearing the age of academic retirement, Prof de Vries is deeply engaged in experimentation, and the cultures in the Botanical Garden at Amsterdam may yet yield results of a theoretical and practical importance in evolutionary science, scarcely less than that of pangenesis and mutation.

Antarctic Expeditions, Past and Present

Some Heroes of Exploration

A BARREN continent, far from human habitation, utterly desolate, snow-clad, enfenced in forbidding barriers of ice. Yet around it circle and twine in shining paths the tracks of many gallant explorers, who for the last one hundred and forty years have strained every nerve to conquer those inhospitable shores. What priceless treasure, what thing so coveted of men does this lonely waste harbor, that they should brave the perils of famine and an icy death in their quest? No ordinary material reward is that they seek; theirs is an ideal goal, the thirst for knowledge, the spirit of scientific exploration, and no doubt the love of a manly fight against desperate odds, these are some of the motives that fire them. And it is for us, who stay at home in safety and comfort, reading the history of their doings, to catch some faint spark of inspiration from the exploits of those gallant men and hold as we also reap the material benefits which flow from their scientific labors.

The first antarctic expedition falls into that period which is so peculiarly replete with important events, both in the world of politics and in the realm of science. We read in a leaflet issued by the American Museum of Natural History, that in 1772, Capt. Cook of the British Navy, was commissioned by the Admiralty to command two vessels to examine into the question of the existence of a great southern continent. He sailed from Plymouth in July, reached Cape Town in October, and entered the area shown in our front page illustration near the 20th meridian of east longitude. The first part of his course will be seen putting forth a nose toward Enderby Land, which appears near the "horizon line" and to the right from the center. Cook next proceeded along an easterly course then turned abruptly south, and on January 17th, 1773 was the first person to cross the antarctic circle. Cook continued his travels, the line of which will be seen again and again in different portions of the accompanying map though part of his course lies outside the area covered thereon. In January, 1774 he reached his farthest southerly point, 71 degrees 10 minutes, near 110 degrees west a record which was not broken for half a century. It is noteworthy that Cook, the first successful antarctic explorer, not only completed the circumnavigation of the antarctic but proved the non-existence of any antarctic land mass extending north of the antarctic circle.

The next South Pole expedition of any importance was carried out under the patronage of Alexander II of Russia who appointed Bellingshausen to the command. This explorer sailed in January, 1820, with two vessels. His course also will be found sketched on the accompanying map. He crossed the antarctic circle some six times, and discovered Peter Island, the most southerly land then known. He did not, however, go quite as far south as Cook, but only reached 69 degrees 52 minutes.

In 1823, an Englishman named James Weddell, forced two small sealing vessels southward through the sea which bears his name, to 74 degrees 15 minutes south, a point 214 nautical miles nearer the pole than Cook's farthest travel, thus breaking the record that had stood for nearly fifty years. Weddell's course will be seen on the map near the horizon a little to the left of the center.

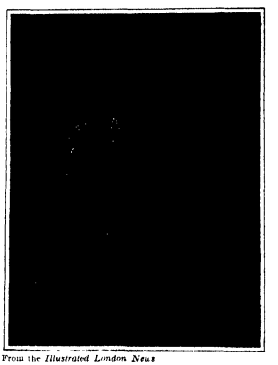
Enderby Land, to which we referred in indicating the position of Cook's course on the map, was discovered in 1831 by Biscoe, a British sealer, exploring under commission from the merchant firm of Messrs. Enderby. The course of Biscoe will be found on the map, forming a loop thrown over the antarctic continent.

An expedition sent out by France in 1837 under Commander d'Urville deserves mention as being the last French south pole expedition until recent times.

In 1839, Lieut. Charles Wilkes at the head of the United States exploring expedition, with a squadron of six vessels poorly equipped and poorly adapted for polar work, entered the south polar regions from Tierra del Fuego. His course will be seen on the accompanying map, approaching the antarctic continent near the center of the map and following the coast line westward (to the right). In his journey through what is known as Wilkes Land, he took a course more southerly than any previous explorer known to him had traveled in this region.

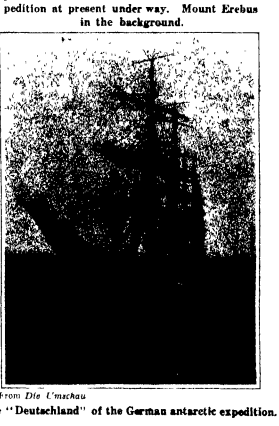
James Clarke Ross, a nephew of Sir John Ross, the arctic explorer, and one who had several years of arctic experience, left Tasmania in 1840 in command of the "Erebus" and "Terror." The primary object of the expedition was to make certain magnetic explorations in the extreme south. In less than five months Ross returned to report the extraordinary results of his expedition. His course will be seen indicated by a tortuous white line tangled over the Ross sea.

Fully informed concerning the discoveries of Wilkes,



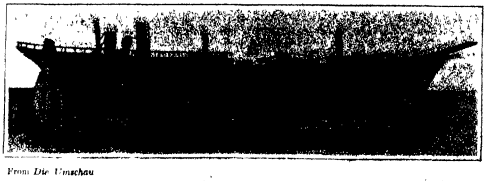
From the Illustrated London News

Capt. R. F. Scott, leader of a British antarctic expedition at present under way. Mount Erebus in the background.



From Die Umschau

The "Deutschland" of the German antarctic expedition.



From Die Umschau

Longitudinal section through the "Deutschland."

1. Rudder. 2. Closet. 3. Small saloon. 4. Captain's bridge. 5. Ventilator. 6. Kitchen and dresser. 7. Living and dining room. 8. Hatch. 8a. Pump. 9. Laboratory. 10. Horse stables. 11. Dog kennels. 12. Provisions. 13. Large boiler. 14. Small auxiliary boiler for the dynamo. 15. Coal. 16. Provisions. 17. Various utensils. 18. Men's quarters. 19. Briquettes 20. Chain ballast.

ANTARCTIC EXPEDITIONS, PAST AND PRESENT

James Clarke Ross, a nephew of Sir John Ross, the arctic explorer, and one who had several years of arctic experience, left Tasmania in 1840 in command of the "Erebus" and "Terror." The primary object of the expedition was to make certain magnetic explorations in the extreme south. In less than five months Ross returned to report the extraordinary results of his expedition. His course will be seen indicated by a tortuous white line tangled over the Ross sea.

Fully informed concerning the discoveries of Wilkes, he determined to seek high altitudes to the east of the Balleny Islands, and with little difficulty sailed into a new sea and discovered land extending from Cape Adare to the volcanoes of Erebus and Terror, 77 degrees south, a distance north and south of approximately four hundred miles. He thus reached a point considerably farther south than any attained by previous explorers. He finally reached England in September, 1843, having been absent for more than four years.

In 1874 the first steamship, the British vessel "Challenger," entered the antarctic. It was also the first to be equipped with adequate sounding and dredging apparatus. As a result of the "Challenger's" investigations the existence of an antarctic continent was proved, and the fact that a wealth of animal life covered the floor of the south polar seas was well established. The course of this expedition under the command of G. S. Nares appears on the map near the upper right-hand corner.

During the last quarter of the nineteenth century with the waning of the whaling industry in the north, and the report of the existence of large numbers of whales in the south, the small steam whalers of Scotland and Scandinavia made several expeditions into the antarctic. Among these was the "Jason," commanded by Capt. Larsen, whose course appears near the horizon to the left of the center of our map. Larsen discovered the first antarctic fossils, which proved that at least part of this region is not volcanic.

During the years from 1902 to 1904, Capt. R. F. Scott, commanding the "Discovery," a well equipped vessel manned by British navy officers and bearing a scientific staff of well qualified men directed a south polar expedition in which among others Shackleton took part. On November 2nd 1902, Scott, Shackleton, and Wilson began their heroic sledge journey over the polar ice to the south, a distance of 380 miles from their ship. They planted the British flag at 82 degrees 17 minutes south. The following winter was spent in the antarctic under conditions of intense cold, the thermometer frequently registering fifty degrees below zero and even reaching 68 degrees. It appeared at one time as if the "Discovery" must be abandoned, and the crew return on one of the relief ships that had been sent after them. But on February 16th, 1904, she was released from the ice and sailed for home. Scott's course will be seen indicated, extending roughly along the median north-south line on our map.

A Scotch expedition explored the south polar regions during 1903-1904 and among other things discovered Coats Land. The commander was W. S. Bruce, and his course appears right in the center of the horizon in our illustration.

We come now to the last and most successful of all the south polar expeditions. Early in 1908 Lieut. Shackleton on board the "Nimrod," with a party of about fifteen men, dogs, Siberian ponies, a motor car and other equipment, entered the antarctic regions near the 180th meridian. Passing through Ross Sea and along the edge of the great ice barrier they almost reached King Edward VII. Land but found further progress in that direction blocked by impenetrable pack ice. They then proceeded to Cape Royds near the volcano, Mount Erebus. Here the "Nimrod" left them and went north, to return the following spring. Relatively elaborate winter quarters were established at Cape Royds in a specially designed hut made of cork. In March, 1908, a party of six ascended Mount Erebus to its summit, 13,500 feet above sea level.

On October 5th, 1908, a party of five started on its journey to the South Magnetic Pole, which was reached on January 16th, 1909. The position of the magnetic pole was determined to be 72 degrees 25 minutes south, 155 degrees 16 minutes east. The south point of the compass always turns toward this point. Therefore, between the South Magnetic Pole and the South Geographic Pole the south point of the compass is directed due north. This party, returning to the coast February 3rd, was picked up by the "Nimrod" and taken to Cape Royds.

On October 29th, 1908, Shackleton and three others—with a supporting party of five, which turned back November 7th—set out for the South Geographic Pole. They followed, roughly, the 163d meridian east until in late November they

reached Scott's farthest south—82 degrees 17 minutes south. Christmas day found them at 85 degrees 55 minutes south, and by 9:00 A. M., January 9th, 1909, they had reached 88 degrees 23 minutes south Beyond this point they could not go on account of the hard traveling and the exhaustion of their food supply No mountains were visible beyond, and it is probable that the South Pole is situated on a level plateau 10,000 to 11,000 feet above sea level After an extremely hard return journey on short rations, Cape Royds was reached March 4th, 1909 The "Nimrod" and the supporting and relief parties were there waiting, and the next day all started for home

In addition to discovering the South Magnetic Pole and reaching a point within 110 miles of the South Geographic Pole, the main results of the journey were the finding of coal (showing that in the past this region enjoyed a mild climate), the procuring of a complete meteorological record and the discovery of eight distinct mountain ranges varying from 3,000 to 12,000 feet in altitude

Into approximately the same period as Shackleton's expedition falls Charcot's voyage on the "Pourquoi Pas" in the Antarctic (1908-1910) In sportsmanlike spirit this French explorer refrained from entering a region which, as he considered, had been "staked out" by the British expeditions "I resolved," he writes, "to return to the region which I had begun to explore on the "Français" in 1903-1905, i e., that mountainous projection, due south of Cape Horn, improperly known under the general name of Graham Land My exact object was to study in detail and from all points of view as wide a stretch as possible of the Antarctic in this sector of the circle" Dr Charcot has presented an account of his travels in popular form in a very interesting book published under the title "The 'Pourquoi-Pas' in the Antarctic"

No less than five south polar expeditions are at present in progress or contemplated An English party is out under the command of Capt R F Scott, while a Norwegian campaign is headed by Amundsen Recently Sir Ernest Shackleton has made an appeal on behalf of an Australasian antarctic expedition under the command of his old comrade, Dr Douglas Mawson, whose desire it is to chart a stretch of unknown coastline some 1,200 miles north of Capt Scott's objective, and to check the readings made by former expeditions at and near the south pole

The Japanese also are now for the first time entering the field, Lieut Shirhase being expected to start out from Sidney in September There seems to be a general impression among connoisseurs that the Japanese expedition is not properly qualified for successful work,

A German expedition started out from Hamburg in May of this year under the leadership of Dr Filchner and Capt R Vahsel The principal object of this expedition is to determine the relation of the eastern and western antarctic continent and to ascertain whether they are continuous or separated by water A somewhat detailed account of the plans and equipment of this expedition is given in *Die Umschau*, from which our illustrations of the "Deutschland," the vessel which is to carry the explorers, are taken The "Deutschland" was originally built in 1906 as a whaler, and is constructed wholly of wood, as this is found, by virtue of its elasticity, to resist the crushing effect of ice better than a steel hull In fact a steel vessel is apt to be simply cut by the ice, while a wooden craft is pressed up out of the floes The "Deutschland" is rigged as a three-master and carries a 300 horse-power auxiliary engine which in an emergency renders the ship independent of the wind The length over all is 183 7 feet, the beam measures 34 1 feet, and the depth 22 6 feet The tonnage is about 550 The auxiliary engine is capable of developing a speed of seven knots The propeller is two-bladed and can be drawn upon the deck when not in use, so as to protect it from the ice The rudder is similarly arranged to be raised out of the ice,

The greater part of the ship's space is of course taken up by the hold which contains the provisions the drinking water and the supply of coal for the three and one-half years which the expedition is planned to last The general arrangement of the ship's interior is well brought out in one of our illustrations The cost of the expeditions is estimated at $375,000, every cent of which has been contributed from private funds The sledge journey is planned to start from the Weddell Sea (as indicated on our map) The final equipment of the ship for its journey will be made at Buenos Aires where a part of the provisions the automobile sledges Manchurian horses and Eskimo dogs will be taken on board The boat is lighted by electricity, and a powerful wireless telegraph apparatus, which will maintain communication with South America The crew numbers thirty five and the provisions take up 200 tons of the ship's space The plans are laid with characteristic German thoroughness

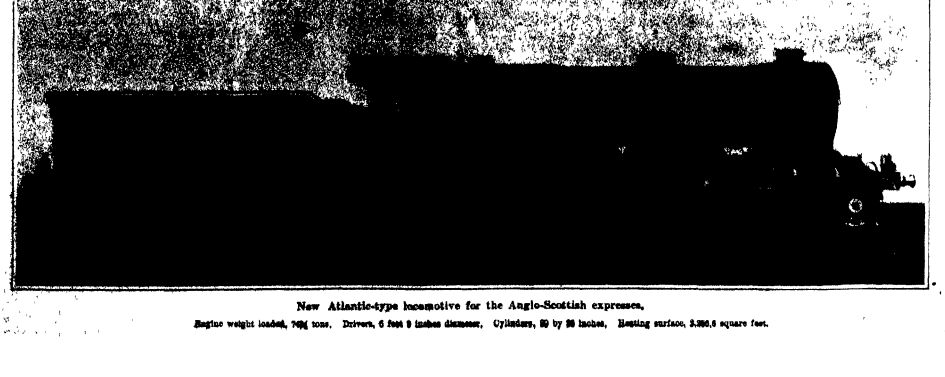
New Atlantic-type Locomotives for the Anglo-Scottish Expresses

Increasing Use Abroad of Large Boilers and Heavier Loads on Drivers

By Frederick C. Coleman

THE North British Railway Company has this autumn introduced six Atlantic-type locomotives for hauling the Waverley expresses They were built by Messrs Robert Stephenson & Company (Limited), of Darlington, England, to carry a 20-ton adhesion load on each coupled axle, which weight is usually regarded as the limit for British railways An adhesion load of 40 tons in a four-wheel coupled locomotive for Great Britain needs large cylinders, and the dimensions here employed, viz., 20 inches by 28 inches, could not be exceeded without throwing an enormous strain on the steaming capacity of the boiler The long piston-stroke facilitates easy starting, and, with the relatively large cylinder diameter, provides an ample volume for the expansion of steam, so that a low terminal pressure is assured without resorting to compounding The cylinders are carried outside the frames and steam is distributed to them by means of piston valves actuated by Stephenson link motion The cylinders are 6 feet 8½ inches apart between centers, and the pistons are provided with tail rods working in tubular sleeves The main frames are set in at the rear of the bogie to permit of greater side movement on the part of the latter The coupled wheels are 6 feet 9 inches in diameter, the bogie wheels 3 feet 6 inches in diameter and the trailing wheels have their axle boxes carried in outside framing, so that neither the length nor the width of the firebox, which is of the Belpaire type, need be restricted The grate area is 28.5 square feet The boiler has an outside diameter of 5 feet 4⅝ inches and the barrel is 15 feet 4¼ inches long between tube plates Its center is 8 feet 11 inches above the rail level and the working pressure is 200 pounds per square inch

The total heating surface amounts to 2,256 6 square feet The firebox contributes 184 8 square feet, and the tubes, 257 in number, and 2 inches in external diameter, the remaining 2,071 8 square feet The engines are each fitted with combination injectors and lever reversing gear, and are provided with a steam cock with a reducing valve on the tender for carriage-heating purposes Sandboxes have been provided for the leading and driving wheels, the sand being blown on to the rail by air pressure The engines are equipped with standard Westinghouse brakes, and have a vacuum ejector and train pipes, so that they may handle vacuum brake-fitted trains, if necessary The weight empty is 67 tons 2 hundredweight, and in working order 74 tons 15 hundredweight, this last being distributed On the front bogie wheels, 8 tons, on the rear bogie wheels, 8 tons 7 hundredweight, on the four coupled wheels, 40 tons; and on the trailing wheels, 18 tons 8 hundredweight The tender is of the usual six-wheeled pattern and of the standard North British Railway type, and it has a tank capacity of 4,200 gallons of water and 7 tons of coal, the weight in working order being 46 tons 5 hundredweight. In running order, these Atlantics have an aggregate weight on the rails of 121 tons, while the engine length is 38 feet 3½ inch, the total wheel base 27 feet 9½ inches and the length over buffers 63 feet ½ inch



New Atlantic-type locomotive for the Anglo-Scottish expresses.

Engine weight loaded, 74½ tons. Drivers, 6 feet 9 inches diameter. Cylinders, 20 by 28 inches. Heating surface, 2,256.6 square feet.

Three Million Matches a Minute

IT has been estimated that, for each minute of time, the civilized nations of the world strike three million matches This is said to be the average for every minute of the twenty four hours of the day Fifteen hundred billion is the number for the entire year and those persons who live under the American flag are charged with the consumption of one-half of this amount

The importance of the industry which turns out the little splinters of wood tipped with sulphur or some other material ignited by friction, is only recognized when the average smoker tries to contemplate his predicament if he had to go back to the time when he had to coax a spark from a tinder-box Small and insignificant as it is, the match demands as much attention in the choice of the wood involved in its manufacture as any other forest product Only the choicest portions of the best trees are suitable Sap wood knotty or cross grained timber will not do Instead of being a by-product, the little match is turned out at hundreds of mills over the country where the by-products are bulky objects like doors sash, shingles, sidings, posts, and cord woods The pines linden, aspen, white cedar, poplar, birch and willow are the most suitable match timbers

Abstracts from Current Periodicals

Phases of Science as Other Editors See Them

Instantaneous Roentgen Ray Photography

THE sharpness of Roentgen ray skiagraphs of parts of the body is often impaired by voluntary or involuntary movements of the patient This difficulty would not exist if "instantaneous" or exceedingly short exposures could be substituted for the usual "time" exposures In order to obtain Roentgen rays of sufficient intensity for use in instantaneous exposures, the Roentgen tube must be excited by a single electric wave or pulse, produced by a very large induction coil In the well known Vesta apparatus this result is accomplished by melting a fusible plug in the primary circuit by an overload of direct current

The Erlangen firm of Reimger Gebbert & Schall has recently put upon the market an apparatus in which the single wave or "unipulse" is produced by means of a specially constructed interrupter This device consists of an amalgamated copper rod, surrounded by a closely fitting sheath of insulating material, and dipping into a vessel which contains mercury, covered by alcohol

When the rod is drawn out of the mercury it draws some of the latter after it into the insulating sheath The heat developed in the slender column of mercury by the strong current employed causes the column to break with explosive violence, and drives the mercury downward with great velocity which is increased by the heat of the self-induction spark which immediately follows the rupture of the mercury column The primary circuit is consequently broken with extreme suddenness, independently of the speed with which the rod is raised, and a spark of corresponding intensity passes between the secondary terminals Fig 1 shows the appearance of this spark in ordinary conditions and Fig 2 shows the deformation produced by placing the spark gap in the strongest part of the coil's magnetic field A Roentgen tube excited by this single induced wave, or "unipulse" emits Roentgen rays of sufficient intensity to make strong skiagraphs of thick parts of the body (Fig 3) in 1/200 second



Fig. 1. Unipulse spark.



Fig. 2.—Unipulse spark in magnetic field.



Fig. 3.—An instantaneous skiagraph.

Why Fog Signals Fail

IN a chart published by the United States Weather Bureau, and reproduced here in abridged form, Prof A G McAdie discusses some of the phenomena presented by fogs and the difficulties and dangers which arise therefrom to navigating vessels, especially near shore

The fogs of the Pacific, and especially those on the coast of California, Oregon and Washington, present some characteristic features of their own They are low lying, dense and of frequent and regular occurrence and have been the cause directly and indirectly of a large per cent of marine disasters In the vicinity of San Francisco owing to the general movement of the air from the sea toward the land, and the climate of the great interior valley, fog is frequent and well marked In summer the afternoon sea fog varies in depth from 100 to 1,700 feet, but it rarely reaches far inland On some afternoons the velocity of the wind at San Francisco rises with almost clock-like regularity to about twenty-two miles per hour, and a solid wall of fog, averaging 1,500 feet in height, comes through the Golden Gate, causing a fall in temperature to about that of the sea, namely, 55 deg F The upper level of the fog can be plainly seen from the hills in the vicinity, and it is interesting to note that above the fog level the air is cloudless and the afternoon temperature ranges from 80 deg F to 90 deg F

While the Pacific fogs occur with peculiar regularity, those of the North Atlantic Coast, though at times persistent, are irregular both as to the time of their occurrence and their duration The North Atlantic Coast fogs are probably due to thin strata of warm moist air passing over the cold water surface The summer afternoon sea fogs of the Pacific are also quite different from the winter morning fogs The latter lie low, close to the surface of the water, and do not average more than 100 feet in depth It is nearly always possible, by sending out a look-out, to get above the level of the fog and thus obtain proper bearings With the summer afternoon sea-fogs this is out of the question. The distance which the fog extends seaward is not definitely known, but it is thought that an average would be about 50 miles.

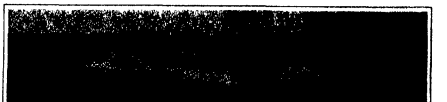
There are instances when a fog has been reported several hundred miles off shore

Whether a fog appears for a few hours at certain seasons, as on the Atlantic Coast, or regularly through the summer afternoons and the winter mornings, as along the Pacific Coast, whether it forms sharply defined streaks and strata, as at San Francisco, or lies in undefined banks, as off Newfoundland, in either case it is due to a cooling of the air and consequent condensation of water vapor The cooling may be brought about by elevation and expansion or by rapid radiation or by mixture with a cooler mass of air or contact with a cooler surface The water vapor condenses on minute nuclei which may be exceedingly fine dust or possibly ions

The morning winter fogs are low lying banks of condensed vapor which, as a rule move from the land seaward and are probably formed by a cooling due to radiation and contact, the land surfaces being much cooler in the early morning hours than the water surfaces, owing to the high specific heat of water The summer afternoon fogs are probably due to cooling caused in part by elevation and expansion and in part by mixing Fogs, as a rule, form when cool air passes over warm, moist surfaces, but in the case of the fogs near the Golden Gate, San Francisco, where the surface temperature is 55 deg F, and the air temperature, at a height of 700 feet, 80 deg. F., condensation is more probably due to a mixing of air currents having different temperatures, humidities and velocities.



A billow on a sea of fog.



Fog surface broken by waves and splashes.

The seemingly unaccountable failure of fog signals at the critical moment has been a source of much perplexity and serious disaster. It not infrequently happens that the master of a vessel will testify that the fog whistle could not be heard, while light-house officials will maintain with equal positiveness that there was no failure to give the proper signal. It is now known that both sides may have been correct in their statements. If sound travels through a medium, such as air, the density of which varies more or less from point to point, it suffers a refraction, or, in other words, the line of propagation is not a straight line. As a result of this it may occur that a sound wave, starting from some point on the surface of the earth, is deflected upward, so that a person stationed at some distance on the surface of the earth will receive no indication of the sound wave, which passes over him, above his head, leaving him unconscious of the disturbance.

Another possible cause through which sound signals may become inaudible at certain points is the reflection of sound from sharply defined clouds or banks of dense fog. Such reflection may have the result that at certain points the direct wave and the reflected wave just neutralize and the sound becomes inaudible

The troubles to which air signals are subject are completely overcome when water is used as the transmitting medium The success of submarine bell signals has been so marked that in time the siren signals through the air will probably become of secondary importance Where both signals can be employed and used simultaneously, a careful determination of the interval between the receipt of the two signals enables the mariner to obtain some indication of his distance from the point of starting of both signals, for obviously the time which elapses between the receipt of the two signals is the difference between the time taken for the air signal and the water signal to reach him. Now the velocity of sound in air is about 1,100 feet per second, in water about 4,700 feet per second. From these data the distances may be computed.

The same principle can be applied with still more satisfaction if one of the signals is given by wireless telegraphy and the other through the water. It is claimed that the bells used as submarine signals can be heard farther, under ordinary conditions, than the siren, and furthermore, by means of a special telephone apparatus, it is possible to determine the direction or the origin of the sound. The receiving apparatus consists of two tanks placed in the hold of the vessel below the water-line. These tanks contain microphones immersed in liquid and connected to the pilot house. An indicator box shows the side on which the responding telephone is connected, and the master is thus able to ascertain the direction from which the signals come.

The Rubber Supply of the Future

THE *Chemical Engineer* publishes an article by Mr Walter Freudenberg of Bremen on the subject of the future rubber supply.

The estimated planted acreages of rubber as given by three of the leading trade publications are as follows: *India Rubber Trades Diary*, 776,000 acres; *India Rubber Journal*, 980,000 acres; *Gummi-Zeitung* (Berlin), 1,310,000 acres; Mr. Freudenberg takes the second estimate as the basis for future yields, and gives the future supply as follows: From Malaya, 70,000 tons; Ceylon, 13,000 tons; Dutch Indies, Borneo, South Mora, and Burma, 20,000 tons; total annual supply of plantation rubber in 1916-17, 109,000 tons. To this must be added the probable supply of wild rubber, which until recently has been about 70,000 tons annually. He considers, however, that the supply from this source may decrease, and estimates only 35,000 tons, making a gross total of 144,000 tons in 1916-17. Statistics show that for the year ending June 30th, 1910, a total of 76,000 tons was used, showing an increase of 5 per cent annually during the past 10 years; if this rate continues, about 107,000 tons would be required by 1916-17.

Results of the Glidden Tour

Lessons to be Learned from the Annual Automobile Endurance Contest

INSTEAD of a distinctly technical contest, such as was held last year, the Glidden tour of 1911 was more of a pleasure event held for the double purpose of emphasizing the good roads movement in the South and at the same time of giving the 1912 models their first practical demonstration. The distance covered this year was only half that covered in 1911, being the 1,454 miles between New York city and Jacksonville, Fla.

The tour started on October 14th and ended October 26th In all some 77 cars were included in the caravan, of which 64 competed. Fourteen, or about 22 per cent, finished with perfect scores, whereas last year, out of 27 contestants, none escaped without penalization. Instead of the rigid technical examination that occurred at the end of the tour last year, the rules this year merely required the reaching of controls on time. The cars were divided into teams of three, the winning team, of course, being the one with the fewest marks. In addition to this, the Chamber of Commerce of Anderson, S. C., donated a $1,000 prize for the car having the best score.

The first few days of the tour were very enjoyable, but the tourists encountered a cloudburst at Roanoke, Va., after which they were obliged to travel through exceedingly muddy roads, as well as to ford streams at several places. That they succeeded in doing the latter with the water almost up to the frames of the cars in some instances, speaks well for the manner in which the carbureters and magnetos are protected in the modern automobile

In our report of the tour last year a warning note was sounded regarding that most important part of the car—the steering gear The breaking of steering knuckles or the failure of other parts of this gear were in 1910 of much too frequent occurrence This year but one such accident was reported, but that, unfortunately, was a fatal one On the day before the tour ended the pacemaking car of J P Walker, in which the owner, his wife, and S. M Butler, chairman of the Contest Board of the A A A., were riding as passengers, ran off the road into a field and upset when going at high speed The chauffeur escaped unhurt, but Mr. and Mrs Walker were both severely injured, and Mr. Butler was crushed beneath the car and killed. The accident, which occurred at Tifton, Ga., after the 42-mile run from Cordele had been made in an hour, was caused either by the steering gear giving way or from the car becoming unmanageable when driven at high speed through deep sand The chauffeur claimed the former was the case There was a great deal of racing throughout the tour, and it is a wonder that there were no other serious accidents.

The winning teams, with the points charged against them, were as follows

1	Tarrytown (3 Maxwells)	0
2	Atlanta No 2 (3 Stevens-Duryeas)	19
3	Jacksonville (3 Cadillacs)	28
4	Atlanta No 3 (3 Fords)	125
5	Live Oak (3 Cadillacs)	279
6	Nashville (3 Marathons)	509

The fourteen cars which had perfect scores were made up as follows 4 Maxwells, 3 Cadillacs, 2 Stevens-Duryeas, 2 Fords, a Columbia, a Mitchell, and a Flanders

The winner of the Anderson trophy, who was picked by lot, was Governor Hoke Smith, of Georgia, with his Maxwell Miss Roberta Marks, of Athens, Ga., was the only lady driver She piloted her silver-plated Columbia, filled with several lady friends, through to the finish with a perfect score

The fact that 11 of the 14 perfect-score cars were low-priced machines shows that the modern light-weight touring car, which can be bought for about $1,000 is, if anything, more dependable than a heavy high-priced machine, especially when it comes to traveling at high speed over rough and muddy roads Under such conditions the light car has the advantage in every way, and to make it all the better, it is the cheapest to buy and to run

Science

Stamp-vending Machines in the German Postal Service.—Automatic machines for selling postage stamps are now extensively used in German post-offices, and have effected a considerable saving in the postal administration, although convenience to the public was the prime motive for their introduction. Nearly 50,000,000 stamps were supplied by the machines during the past year, their value aggregating about $750,000

Surfacing Concrete Electric Light Poles With Mica.—Ground mica is now being used extensively for surfacing concrete in cement work. It has proved very effective for this purpose as it gives an artistic finish to the work, and adds life and sparkle to the surface, taking away that flat, dead appearance that is common to concrete. About five pounds of mica is sufficient to cover 100 square feet. The electric light columns in Lincoln Park, Chicago, were treated in this way Crushed red granite was used with the mica, so that the finished surface has the appearance of polished granite. The granite and mica surfacing material was applied to the inner surface of the square iron trough in which that part of the columns that was to extend above ground was cast When the trough was filled, the top or lid was screwed down, crowding the concrete into all the lines and corners of the mold After the cement had set perfectly, part of the mold was removed to permit the post to cure more rapidly The post was not removed from the mold until it had set for 24 hours at least. After it was perfectly dry the surface was scrubbed with muriatic acid, to remove the cement on the outer face of the granite and mica and leave a clean surface closely resembling that of granite.

An Imperial Chinese Printery.—A few months ago the Chinese government began to erect a modern printery that will require a total expense of $2,000,000. Construction of the building and installation of the printing-plant have been intrusted to American architects The present monetary system of China is so complicated that it is really a very emphatic hindrance to the development of trade and industry In accordance with this system every individual province emits its own currency, and the standard of value is different in every province. For a long time, consequently, a persistent effort has been made to devise and introduce a uniform standard of value for the whole empire, and the construction of the printery in Pekin begins the transformation of the collective monetary system of China. Two years ago the government sent Dr. Chen to Europe and America to study the machinery, and its installation, of the most efficient printeries in these countries, and in accordance with his report the governmental printery of the United States in Washington was selected as a model. It is hoped that the Imperial Chinese Printery may be finished within two years so that it can begin work when Parliament opens in 1913. Besides other experts two American engravers have been employed already to supervise the installation of the plant and to instruct the Chinese in the art of engraving.

Engineering

Our Excellent Lighthouse Service.—It is a curious anomaly that the United States, which possesses the smallest foreign-going merchant marine in the world should possess the most perfectly-equipped and elaborate lighthouse service to be found on the coast line of any nation During the past half century this service has cost $150,000,000, and its maintenance calls for the appropriation of about $7,000,000 annually

Panama Exposition Memorial Tower.—A concrete steel tower, which will be the loftiest structure, with the exception of the Eiffel Tower, in existence, is to be erected at San Francisco in connection with the Panama-Pacific International Exposition, which will be held in that city in 1915 From the floor to the top of the figure of Victory, surmounting the shaft, the height will be 850 feet It is to consist of a square shaft upon a base 232 feet square and 120 feet high The shaft will measure 85 feet on each face The estimated cost of the structure is $1,500,000

Daily Earnings of a Locomotive.—A writer in the *Railway and Engineering Review* recently gave the interesting results of a computation of the average daily earning capacity of the American locomotive The estimate took account of time spent in the repair shop, increased cost of repairs and renewals, and the cost of fuel, water and the engine crew The average earnings per locomotive per day in the East are $124.84, and on the western roads, $130 84 The highest earnings in the West are those of the Santa Fe locomotives, which work out at $149 53 per day The highest earnings in the East are on the Central Railroad of New Jersey, where the average is $147 06 per day.

Steam Turbine Improvements.—The superiority of the reciprocating engine over the steam turbine when a ship is steaming at low speed is destined to disappear. At high speed the turbine possesses every advantage; but at low speed it is extravagant in its use of steam. Of the several systems of reduction gear by which the widely different economical speeds of propeller and turbine are sought to be harmonized, the electric drive seems to present the most promise A better method would be the proper combination of reciprocating engines for low speed and turbines for high speed. The navy has under consideration a system of this kind which we hope shortly to present for the consideration of our readers

Our New Three-gun-turret Battleships.—Plans and specifications are now being prepared in the Navy Department for the two super-dreadnought battleships authorized at the last session of Congress These ships, which will be named the "Oklahoma" and "Nevada," will contain many novel features, the most important of which will be the introduction of the three-gun turret, of which there will be two, containing six 14-inch guns. The other four 14-inch guns will be carried in two-gun turrets. The armor plan has been worked out with great care; and we understand that these ships will be protected by a thickness of face-hardened armor which has never been attempted in any battleship in our own or foreign navies

Aeronautics

Results of the Tests for Military Aeroplanes in France.—The preliminary tests of the 29 machines entered in the competition for military aeroplanes in France have resulted in the elimination of 5 of the 8 monoplanes and 14 of the 19 biplanes Neither of the two triplanes—the Astra and the Paulhan—was selected The machines which were scheduled to participate in the final 185 mile speed race on November 4th were the Morane, Nieuport and Deperdussin monoplanes, and the Breguet, Savary, H Farman, and M. Farman biplanes We expect to publish a complete account of these tests in our next issue

The Trans-continental Flight Nearly Completed.—On November 1st Aviator Calbraith P Rodgers covered 177 miles between Wilcox and Maricopa Ariz., and got within 400 miles of the coast At Tucson, the half way point, he met Robert G Fowler who arrived there October 30th on his flight from the Pacific to the Atlantic, and who was delayed with engine trouble and an accident upon restarting The two dauntless Wright pilots shook hands, congratulated each other, and hoped for better luck Rodgers found a number of broken rollers on the propeller chains of his biplane, and was delayed at the start in replacing them Then he had to breast a 30-mile head wind and to climb considerably to get through the 4,351-foot Dragoon Pass. He fought a head wind throughout the entire day, his time *en route* being 1¾ and just over 2 hours, respectively November 2nd he flew 35 miles to Phoenix in 35 minutes, and 105 miles to Stovall in 118 minutes, aided by a strong wind He beat his special train by over two hours

Recent Aeroplane Fatalities.—The last month has witnessed the passing of the hundred mark in aeroplane fatalities October 12th aviator Level fell to his death in a Savary biplane which he was piloting in the French army tests His spine was broken and he died soon after Two other French aviators—Horta and Germain—also fell the day previous One was killed and the other fatally injured The hundredth victim of aviation was Hans Schmidt, who fell at Berne, Switzerland, on October 14th, and was incinerated as a result of the ignition of his fuel On the 21st ult an aviator named Tacks fell and was killed near Hamburg The loss which was most keenly felt in America, however, was occasioned by the death of Eugene Ely, the Curtiss aviator, at Macon, Ga., on October 18th Ely was making one of those daring dips for which Hamilton became famous when he miscalculated and struck the ground with terrific force He was thrown out and his neck was broken Ely was using a machine without any front control, while he had been used to a biplane with a front horizontal rudder The slower response of the former type to a movement of the elevator was doubtless responsible for Ely's death, although the immediate cause was the performing of foolhardy tricks On October 27th Jean Desparmet fell 600 feet in a 100 horse-power Blériot military monoplane at Rheims while on the 31st Prof. John J Montgomery was killed in California.

New Development in Aeroplane Construction

Three European Types Embodying Unusual Features

By Grover Cleveland Loening

QUITE recently there have been brought out in Europe several radical types of aeroplanes characterized by novel departures from accepted practice, and by far the most interesting ones are the new Antoinette, the Pivot, and the Short "twin" engine biplane.

Up to a few months ago, the aviation industry as a whole exhibited work of much ingenuity and cleverness but was wofully lacking in those fine points of pure engineering that go to make any field of applied science a successful one. With the new types that have been developed abroad, however, it appears that thoughtless copying of a few successful "experiments" is giving way to a more detailed and careful study of the countless different conditions occurring in the practice of flying upon which designs with definite ends in view are being perfected. The Breguet biplane and the Nieuport monoplanes may truly be said to represent the pioneer stage of aeronautical engineering, representing as they did, a much higher state of development than any other types. But in France, especially, progress is rapid and it is almost safe to predict that in a short time the Nieuport will be out of date. Many weak features in this type have already been discerned, notably the shape of the body and the landing chassis. At any rate, about the most hopeful sign yet exhibited in the progress of the flying industry is the design and development of aeroplanes with other ends in view than the mere ability to fly and to land without collapsing. Ease of packing for shipment and speed in erection and "tuning up" are factors of great importance that are receiving careful consideration. Many dispositions likely to add to safety and a reduction in the number of parts with a view to simplifying and cheapening manufacture are being developed. So it may fairly be said that we are beginning to emerge from the embryo state of aviation to one that is likely to hasten the advent of its full commercialization.

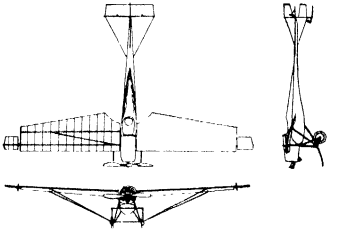
Each one of the types described here bears one or more distinguishing features and they have been admirably adapted in practice to the work for which they were designed.

The Antoinette Monoplane.

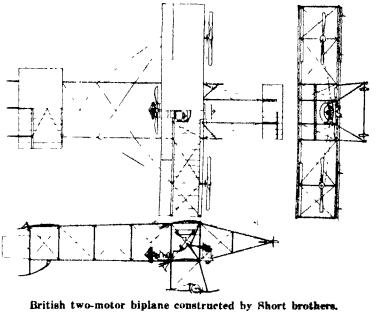
The new Antoinette monoplane, designed especially to take part in the French Military Competition, has an unusually radical appearance. This machine, primarily intended for military purposes is equipped with armor plate protection about vulnerable parts like the motor and chassis, but its most important feature is the total elimination of cross wires, struts and the like. All parts are inclosed—even the wheels and skids—with the result that the resistance is greatly decreased, but the weight increased. In addition a peculiar wing section is used, flat on the under side and curved on the upper side. This type of wing section as learned from aerodynamical experiments has a very bad drift resistance at low angles and a very uniform rate of change of the ratio of lift to drift at low angles. The center of pressure as the angle of incidence decreases below 10 degrees does not move back as rapidly as on other shapes. This type of wing is therefore more stable and of smaller resistance. The distribution of pressure, however, is very uneven, but because of the great strength of the planes themselves at all points, this is not a detrimental feature.

The wings are immensely thick being entirely braced from the inside. At the body the wings are over two feet thick, something altogether without precedent in aviation. Their thickness decreases toward the tips which are about 8 inches thick. The shape of each wing is trapezoidal, and they are at a large dihedral angle. This adds to the stability in a calm, in a gusty wind conditions arise where a large dihedral angle is thought by many to be dangerous.

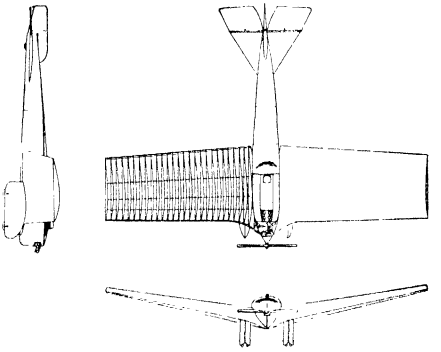
The boat-like body of this new type is entirely inclosed and is capacious to say the least. At the front is the motor, the aviator sits in the body between the two wings, and at the rear are the rudders. The body has a stream line form, and a splendidly shaped prow.



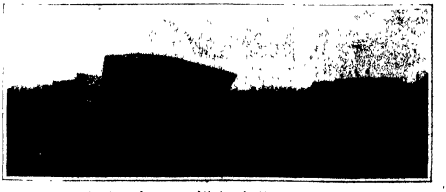
Drawings of Pivot monoplane with ailerons.



British two-motor biplane constructed by Short brothers.



Plan and elevations of "armored" Antoinette monoplane.



Side view of "armored" Antoinette war aeroplane.

A two-bladed Normale propeller at the front pulls the machine forward. The motor is a regular 100-horse-power Antoinette, but the machine will fly with a 60-horse-power motor.

The oddest feature of this type is the landing gear, which is entirely inclosed to within a few inches of the ground, the landing wheels at the front are six in number, three on each side of the center, inclosed in what is called a "skirt." At the rear are two smaller wheels.

The dimensions are roughly as follows. Spread, 52½ feet, area of supporting surface, 602 square feet, length over all, 36 feet; width of wings at tips, over 9 feet, increasing to almost 13 feet at the center. The total weight, including fuel and operator, is nearly 2,400 pounds.

The aviator obtains a view beneath him through a glass floor under his seat. For the reduction of resistance, even the exhaust pipes of the engine are inclosed in a stream line shield.

This type is certainly birdlike in its appearance and immense in size, but whether the great sacrifices made to eliminate projecting spars or wires are wise remains to be seen. For a purely speed machine it would be wise, without a doubt. There is a large expanse of vertical surface in this machine which is likely to make it difficult to handle, especially in a wind. A number of successful flights have already been made, however.

The Short Biplane.

An aeroplane, equipped with two motors, which has already completed duration flights of over an hour and is therefore capable of fulfilling the conditions of the Gould Prize, has been built in England by Short brothers.

In general outline it is a biplane of the 1910 Farman type, equipped with two 50-horse-power Gnome engines placed centrally one in front of and the other in the rear of the lower main plane at either end of a nacelle or inclosed body. The front motor drives two propellers by chains in opposite directions, precisely as on the Wright biplanes. The propellers are of high pitch, shaped like Wright propellers, but are at the front of the main cell. The rear motor drives a single low pitch propeller at high speed, as on the usual Farman type.

It is possible to operate either motor separately or both together. The entire mechanism has worked to the utmost satisfaction, its feasibility being proved beyond a doubt.

The aviator sits in the nacelle, a passenger seat at his side. The rudder and aileron controls are of the usual Farman type.

The landing chassis and in fact all details of construction are very strong.

With the immense extra power available—one motor alone sufficing for ordinary flight—this type has the ability to go fast or slow, and, in addition, on occasion can climb with great rapidity, with its full 100 horse-power. It is to be noted that the axes of the front propellers and the rear one are not on the same level. This is designed to counterbalance the effect on the tail, had by the draft from the rear propeller. As soon as the latter ceases to operate the lifting tail sinks, but the higher position of the axis of thrust of the front propellers at once overcomes this.

The dimensions are as follows: Spread, 34 feet; chord, 6½ feet; supporting area, 435 square feet; weight in flight, 2,000 pounds. The speeds are said to vary from 35 to over 50 miles an hour, depending on the amount of power used.

The Pivot Monoplane.

A highly interesting monoplane has recently been brought out in France, known as the Pivot. Its distinguishing features are the use of ailerons for

NOVEL FOREIGN AEROPLANES

verse control and the manner in which the planes are braced.

The body, of stream line form, suggests a combination of the Deperdussin and Breguet. The motor is at the front covered by a well designed hood. The pilot is comfortably seated at the rear of the main planes which are notched to enable him to have a clear view. The span of the planes is 34½ feet and their area 274 square feet. The weight of the machine is about 600 pounds in flight. A 45-horse-power Rossel-Peugeot motor is used. The wing section is of the now familiar Nieuport type, the wedge-shaped entering edge, however, being noticeably larger, and the reverse curvature at the rear somewhat sharper.

For some time, many engineers have been awaiting the monoplane that should cease to have its planes braced by wires—tension members—above the planes, where they never receive any tensile stress except upon landing. As soon as the machine takes to the air with the full pressure acting on the surfaces, the wires above the plane are relieved of all stress and must in consequence hang more or less loosely, thus generating a considerable resistance. It is recognized, however, that in gusty weather, reversals of stress are likely to take place and tension members alone on the under side of the planes would not suffice. There are two ways, however, in which monoplanes can be efficiently braced with the fewest parts and least resistance. The first way is to have compression members alone, capable of taking tension as well above the planes, and the other is to have tension members capable of taking some compression without undue bending below the planes. It is this latter method that is used on the Pivot two steel tubes below each plane alone suffice to brace it solidly to the chassis. The results so far have shown this to be an excellent provision, no other bracing wires being necessary. Another novel feature is the use of ailerons instead of warping.

Preparations for Launching the "Akron" for Its Trial Trip

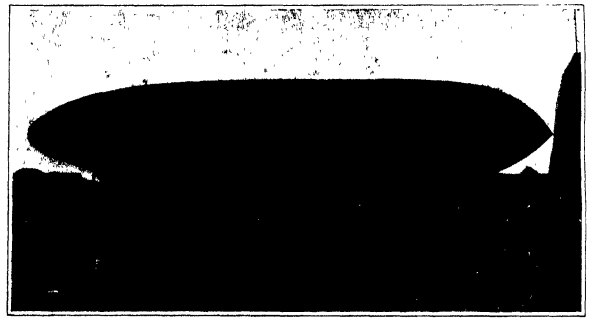
Preliminaries for a More Complete Test

THE announcement was made on October 26th that Mr. Vaniman might, on the next Saturday, make a trial trip with his airship "Akron," familiar to our readers as the craft that is to carry its captain and crew across the Atlantic some time this autumn. While the public has been disappointed so far as the trial trip is concerned, which, at the time of writing, has not yet taken place, the preparations for the trip and the attempt which was made to start out on it, were in themselves of sufficient interest to deserve brief mention in these pages.

Early in the afternoon of Sunday, October 29th, Mr. Vaniman began to make preparations to lead his giant airship out of the shed and, if possible, to make a trial flight. The weather conditions were very favorable, though there was a slight wind blowing, sufficient to call for caution in the handling of the dirigible as it emerged from the shed. A large crowd had assembled in front of the hangar, its front ranks forming a semi-circle around the rope that had been put up to fence off the public from the space allowed for the launching of the airship. The preparations consumed a good part of the afternoon, but finally the "curtains" that form the door of the shed were drawn aside and, loudly cheered by the crowd of people, the leather-colored envelope of the "Akron" began to thrust its rear out of the shed, as a gang of about one hundred men, holding on to the anchoring wires and to the keel of the car, slowly moved the airship out into the open. Even to those who had become quite familiar with the aspect of the balloon by frequent visits to the shed, which was open to the public for a small fee, it was an imposing sight now to see the great craft fully disclosed to broad daylight, with the view unobstructed and the airship out in the open, apparently ready to be launched. This was the first time that the balloon had left the shed, and the men handling it were largely new to the work, so that it was an experiment of some interest. In spite of a wind that was not by any means negligible, the operation was performed perfectly and without a hitch. About two-thirds of the men holding the balloon were firemen and policemen of the Atlantic City force, the remaining one-third being made up of the regular workmen.

No attempt was made on this occasion to make a flight or even to run the engines, but the dirigible was simply led back into the shed just as it had been brought out, and with the same success.

It will be recalled that the airship carries two sets of propellers—one with fixed axes and the other revolvable in such a manner that the propellers can be made to exert their thrust in any desired direction. The first set of propellers and its engine seemed to work satisfactorily, but the right-hand propeller of the second set gave much trouble, its bearings giving out repeatedly whenever the engine was tried. The mechanics were kept busy upon this propeller, the work being carried on deep into the night, and by the next morning, Monday, the indications were that an actual trial would be made that afternoon. As is not unusual in such cases, numberless little complications arose, which delayed the work, so that by the time the balloon was ready once more to be taken out of the shed, it was rather late in the afternoon. The engines were tried in the shed and seemed to work well. The crew and several passengers got on board, and Mr. Vaniman gave the word for the 'Akron" to be slowly drawn out. The operation was performed with the same success as on the previous day, the balloon being slightly turned so as to point into the wind. The attempt to start the main engine from the auxiliary engine, however, proved futile. It appears that a pin in the clutch lever had given out and it was found impossible to repair the damage at short notice. Thus a seemingly trifling cause rendered the flight that afternoon impossible, and with considerable disappointment the crowd presently saw the balloon once more retreating into its hangar as dusk began to fall.



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Airship "Akron" in which Mr. Vaniman expects to cross the Atlantic.

While to those who were expecting to see the airship ascend, the performances of Sunday and Monday must have been disappointing, yet they were really very instructive and interesting. When we consider the great number of little points that require attention, and are liable to go wrong, the wonder is not that these first trials failed to give immediate success, but that it is at all possible to get the entire equipment of the airship under such complete control that it can be relied upon at any instant during an extended flight, a condition which evidently must be most rigidly satisfied for the proposed trans-Atlantic trip.

It is with the greatest interest that we shall follow the accounts of further trials which will precede the actual journey. The time of the year is advancing, and it is to be hoped that successful trial trips will be made within a short time, so that the actual journey may be started before the favorable season of the year closes.

Foreign Accent Marks

A LEADING theatrical company recently toured the United States playing Sardou's "Divorçons." Throughout the country the billboards announcing the event printed the name of the play, in letters a foot high, "Divorcons." This word, written with the right kind of a ç, is French, pure and simple. It admits of no anglicization. As transmogrified by the American printer, it is neither French, English, nor Swahili. As the second syllable, thus printed, rhymes with *pork*, it may be Chicagoese.

Cure is a land of paradoxes, one of the most striking of which is the fact that a people largely recruited from continental Europe should have come to the conclusion that the accent marks used in their various mother tongues are superfluous appendages—mere ornaments, like the paper frills of a French chop. Nothing could be farther from the truth. The European languages, except English, follow the common-sense plan of writing a word as they intend it to be pronounced. Before certain vowels the sound of *c*, in French, bears no resemblance to that of ç. They are, in fact, different letters. *Conde* does not rhyme with *Fronde*. In German, *u* is the modern method of writing the diphthong *ue*. When Herr Muller accepts American citizenship as Muller, he is simply repudiating his family. Better call himself Miller and be done with it. Max Müller was still Müller after fifty years in England, and we are glad to observe Hugo Münsterberg correctly spelled in "Who's Who in America" and other dignified literature. Not so, however, in the American newspapers.

A few years ago an international scientific congress met in Washington, and the local papers paid the foreign visitors the delicate attention of printing their proceedings in what was intended to be French. The result was amazing. Columns of a hybrid language appeared, containing not a single accent. Expostulation with the editors was met with the explanation that the typesetting machines had no accents on their keyboards. Why under these circumstances, the newspapers attempted the job possible was not explained.

The daily press both directs and reflects popular usage. It would be difficult to decide whether the newspapers or the public should be held responsible for the obsolescence of the foreign accent in America.

A painstaking examination of the practice prevailing in such matters reveals the startling fact that only one French word is now generally supposed in this country, to require an accent. This is the word *buffet*. This euphemism for a public bar has become popular in America during the past decade. The word greets us at every street corner always duly provided with an accent. The kind of accent, as well as its position, is a matter of individual taste. We have seen *buffet*, *buffit*, *buffét*—and even *baffit*.

Are there any readers of this journal who need to be told that *buffet* is accentless in French?

Frequency of Electric Oscillations Proceeding from a Spark

THE luminous track of a short electric spark owes its presence to variations in field intensity due to the capacity of the electrodes and the ionization of the air. As a matter of fact it is well known that the spark is oscillatory in character. By blowing a steady current of air through the spark formed a horn electrodes, M. C. Caudrelier, as reported by *Cosmos*, has succeeded in separating the successive tracks of the oscillatory spark by several millimeters, knowing the velocity of the air (20 meters per second) and the distance apart of the individual spark tracks (2 millimeters), it is possible to measure the frequency of the oscillations. In this way it has been found to be of the order of 10,000 periods per second.

A Landsman's Log Aboard the Battleship "North Dakota"—II.

By J. Bernard Walker.

This Landsman's Log is written by the Editor of the SCIENTIFIC AMERICAN as a preliminary to a magazine Naval Number to appear December 9th, which will be comparable in its size and completeness with the Naval Number issued during the Spanish War. In one respect it will be unique, for it will contain a signed message from President Taft, and will be written entirely by prominent officers of the Navy, each a specialist in the particular field that he covers. The leading articles, moreover, will be from the pen of the Hon. George von L. Meyer, the Secretary of the Navy. The illustrations will consist of special photographs taken during the recent maneuvers and target practice of the Atlantic Fleet on the Southern Drill Grounds.

THAT ever-memorable two weeks' cruise with the Atlantic fleet was full of the unexpected and surprising. Returning late one afternoon from witnessing aerial target practice aboard the "Michigan" (of which more anon) I entered my stateroom to find it in a condition of weird disorder. The bureau had been pulled away from the wall, and its glass taken out, wrapped in a blanket and laid on the floor. Beside it, upside down, was the wash-bowl, while the water pitcher had been put to bed in my berth, where it reposed in comical gravity, upon the pillow. On the bedding lay also, a heterogeneous collection of bottles, pictures, electric light fixtures, and even the electric fan. "Rough house" on board the "North Dakota"? Impossible! "Hazing"? Yes, to be sure—hazing the landsman. What more natural and appropriate? Had I not, when crossing the line, seen Old Neptune come aboard, when the luckless landlubber was bedaubed and gently scraped with a barrel stave? So, chuckling over the fun of it all, I went to the wardroom mess, and saw, would you believe it? the piano slung from the ceiling by a couple of stout ropes, and looking even more grotesque than my tornado-stricken stateroom!

Had the good ship's company gone crazy, or had I? Neither the one nor the other, gentle reader. This was merely a very necessary preparation for target practice by our battery of fourteen 5-inch rapid-fire guns, for the discharge of even these relatively small pieces so jars the ship, that any glass or porcelain that was held rigidly in place would be shattered. Even the strings of the piano would snap.

At mess I got the full particulars. The "North Dakota" had fought a terrific battle during the day in which she had been pretty badly knocked to pieces. Big guns disabled—shot holes at the waterline—a compartment flooded—one smokestack gone, the other riddled—speed reduced, and all the other etceteras of damage by shell fire. It had been a drawn battle, but the adjoining coasts of the enemy were swarming with destroyers, and they would undoubtedly be sent in among our crippled ships for a night attack.

And so, when the mess tables had been stowed, the "North Dakota" weighed anchor, and, with lights out, slid silently away from the fleet into the night. No one knew where the enemy might be, or from what quarter the dreaded destroyers might rush at us out of the blackness. It was for us to find him, and pour such a hail of high explosive shells upon the oncoming craft, that they would be disabled or sunk before they could get within range, round to, and start the dreaded Whiteheads upon their fatal run. I went on deck and climbed onto the roof of No. 3 turret, which I found to be crowded, as were the roofs of the other turrets, with sailors (chiefly the turret crews) who had taken this point of vantage to watch the attack.

Suddenly there came a crackling and spluttering from the top of the search-light towers, and half a dozen beams of light stretched their long, ghostly fingers out into the murk. To and fro, far and near over the ink-black waters, they swept, while the great ship, silent, tremorless and dark, forged slowly ahead. It was a tense quarter of an hour, and just as one felt a touch of impatience, there shone out, some 2,000 to 3,000 yards distant, a moving target, looking whiter even than the search-light beams. The target consisted of four squares of gray canvas on a ground of lighter hue, each square the size of a destroyer approaching head-on.

And then comes a flash, more blinding than any lightning stroke, and the crash of an explosion, more wicked and penetrating than the loudest snap of any artillery of the heavens! And see that beautiful, slightly-curving streak of phosphorescence, heading straight for the first square patch. That is the smoke of the shell "tracer." The tracer is a small plug containing combustible material, which is inserted into the base of the shell. It is ignited at the instant of discharge, and throws to the rear a dense trail of smoke, which serves to show the path of the projectile, and assist the spotter and sight-setter in making the necessary corrections for the next shot. The 50-caliber 5-inch rapid-fire gun is a superb little weapon. The shells leave the muzzle with the high velocity of 3,000 feet per second. Consequently the trajectory is very flat, and the moment the blinding flash of the discharge is out of one's eyes, it is possible to see a little phosphorescent spot rise slightly above, and then curve down to the distant target. It curves so slightly that the 2,000 yards seems to be almost a point-blank range. Then comes the splash and the ricochet—the last-named, because of the high velocity, reaching a great height, sometimes curving upward a thousand yards or more into the heavens.



"And then comes a flash, more blinding than any lightning stroke, and the crash of an explosion, more wicked and penetrating than any artillery of the heavens! And see that beautiful, slightly-curving streak of phosphorescence, heading straight for the first square patch. That is the smoke of the shell 'tracer.'"

REPELLING A TORPEDO NIGHT ATTACK

In all target and battle practice, the time element, as well as the accuracy, is taken into account, in determining the relative excellence of the work done by the various guns. Hence, the report of the guns came in rapid succession; and often it was possible to see several shells in the air at the same time, one or two between gun and target, and several others—earlier shots—completing their ricochets in a series of vast sweeping curves extending miles beyond the target, the shells bounding over the black waters like a series of luminescent tennis balls.

Commanding forward, with No. 1, each battery in turn fired its quota of rounds. The guns roared and roared down the line until No. 14, the last on the port side, had let go its last shell. The "North Dakota" then headed for the target, to learn what kind of shooting she had done, and sent a boat over to

remove the shattered squares of canvas and put fresh ones in their place for the next run, with starboard batteries engaged.

Acting gladly on the suggestion that I should now stand in one of the gun casemates and witness at close range the work of the gun crew, I chose battery No 13, the aftermost battery on the starboard side. The casemate port is cut away to allow the gun to be trained dead astern; and the great width of the opening, coupled with the fact that this gun carries no shield, affords a large field of view for watching the course of the shells. What I saw, our artist has endeavored to depict in the accompanying engraving It should be understood that only a part of the gun crew is shown. As a matter of fact, in addition to the officer in charge, there are ten men to each gun First, the gun captain, in charge of the crew, who opens and closes the breech Second, the pointer, who stands to the right of the gun, on a platform attached to and moving with the gun mount This man, by means of a handwheel, elevates and depresses the piece, keeping the horizontal wire of the telescopic sight upon the target. He also fires the gun by trigger, closing an electric circuit. Third, the trainer, who stands on a similar platform to the left of the gun. His duty is to keep the vertical wire of the telescope upon the target, which he does by means of a handwheel that trains the gun to right or left. Fourth, the sight-setter, with telephone head-piece in place, who stands to the rear of the trainer, and by means of a graduated disk and cylinder, sets the sights according to directions as to elevation and deflection, telephoned to him by the spotter, who is watching the fall of the shots from some elevated position on the ship. Fifth, the loader Sixth, the primer man, who inserts the primer the instant the breech is closed. Seventh and eighth are the first and second powder man; and ninth and tenth are the first and second shell man. The battery here shown was manned by a detachment of the marines, of which most efficient corps, 66 men and two officers, a captain and a lieutenant, are to be found on each first-class ship

As I entered the casemate, No 2 battery on the port side commenced firing, and battery after battery roared and flashed down the ship's broadside I noted that to the right of the gun and to the rear of the group of men stood a row of copper cases, each containing its charge of powder neatly sewed up in a canvas bag On the opposite side of the crew was a row of sharp-nosed 6-inch shells. As the din of the firing comes nearer, there rings out the sharp command to "load" Instantly, with one swing of the lever, the gun captain opens the breech, the shell man thrusts home a shell, and the powder man the powder charge With another swift swing of his arm the gun captain brings over the breech block, which is slammed into place and locked Meanwhile the powder men, shell men and primer man have picked up their respective pieces, and stand ready for the next loading. Months of training have developed the gun crew to a point at which (were it desirable) the gun could be fired at the rate of twenty shots every minute

And now the heavy jar of the ship, the blinding flash and curiously stunning effect of the discharges, tell us that No. 11 gun in the next casemate is engaged The tension increases until it is almost a pain, the crew stand as alert as a football team waiting for the pass of the ball! Pointer and trainer, each with eye to the telescope and shoulder crowded firmly against the gun sleeve, are ceaselessly rocking the handwheels to and fro as they keep the wires upon the distant gray patch upon the target "Fire!" comes the command—the steel floor of the casemate shudders, there is a flash that seems to burn the very eyes out of their sockets, and a curious suffocating sensation at throat or chest, and I am peering eagerly through the casemate opening to watch that little magic phosphorescent pencil point trace its tell-tale path to the target Nine times in succession comes that amazing burst of flame and ear-splitting crash—and the night firing for 1911 is over

Later, and long past the midnight hour, the canvas targets, each rolled up on its battens, are brought aboard the quarter deck to be inspected by the ordnance officer and the umpires One of the searchlights is turned down upon the deck, and one by one the targets are unrolled and the shot holes counted Ordinarily the sailors turn in early—but not to-night Massed around the targets, crowding the rail on one side and the 12-inch turrets on the other, they watch the count, looking eagerly for those little jagged holes in the cloth which tell of the passage of the shells Less demonstrative, but no less eager, is the interest of the officers—and when it was told that 98 hits out of 120 rounds had been made, and the "Delaware's" score of the previous night had been beaten, the enthusiasm of that ship's company was as that of the grandstand and bleachers, when the home team has come out ahead in a championship struggle.

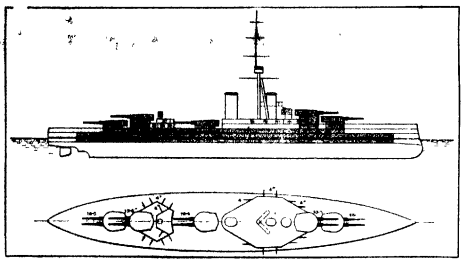
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The Battleship "Orion"

The First British Super-Dreadnought

By Percival A. Hislam

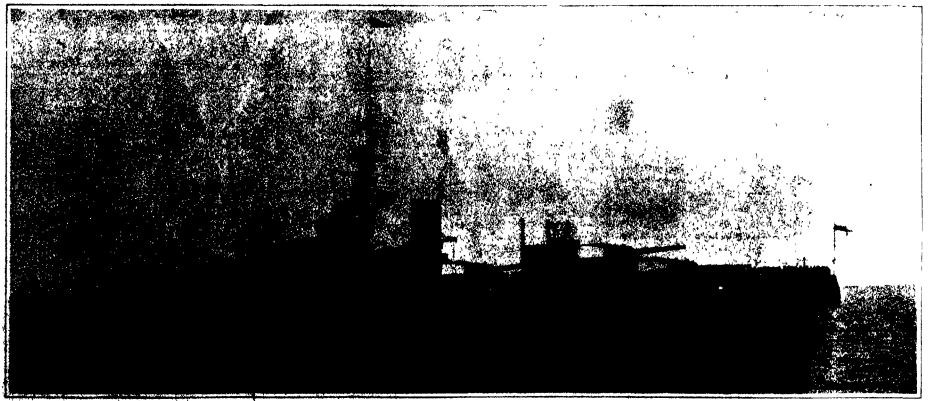
THERE are many points of interest to be noted in connection with the completion of the British battleship "Orion," which, having completed her trials, is now being prepared for commission. In the first place, the "Orion" is the first completed vessel to mount the new 13.5-inch 76-ton gun. Secondly, she is the first British ship of the all-big-gun type to carry her five turrets on the middle line Thirdly, she is the first British armored ship to exceed a tonnage of 20,000 The figure has been reached and closely approached before. Thus, the "Neptune" displaces 19,900, and the "Hercules" and "Colossus" 20,000 tons The tonnage of the "Orion" is, however, 22,500, which is still slightly below the displacement of the German battleships "Helgoland," "Thüringen," and "Ostfriesland," now in service with the High Sea Fleet



Outboard profile and deck plan of "Orion," showing disposition of guns and armor.

The "Orion" left for her preliminary trials on September 11th, twenty-one and a half months from the laying of the first keel plate No single detail of the vessel has been officially published but the following are her principal dimensions Length (between perpendiculars), 545 feet, length over all 584 feet, beam, 88 feet 6 inches, mean draft, 27 feet 6 inches The machinery is of the Parsons turbine type the designed horse-power being 27,000 for 21 knots On the full speed trial the contract speed was exceeded by a knot It is interesting in this connection to note that of the eleven completed British dreadnoughts only two have failed to make 22 knots, namely, the "St Vin-

(Concluded on page 438)



Displacement, 22,500 tons. Speed, 21 knots. Armor: Belt 12 inch, turrets 12-inch. Armament: Ten 13.5 inch and twenty 4-inch guns

British battleship "Orion"—first of the super-dreadnoughts.

Simple Tests for Food Purity

What the Housewife May Do to Detect Adulterations

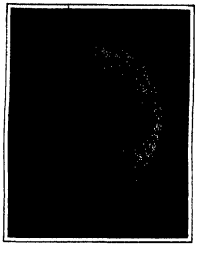
By S. Leonard Bastin

FROM time immemorial the freshness or otherwise of an egg has been a perplexing problem to the housewife. Even at the present time it is probable that the majority of people do not know how to tell whether an egg is good enough until they have broken it. This is strange inasmuch as the method of finding out the condition of eggs is so simple that anyone can follow it, moreover, the test given is one which is relied upon by the trade and may therefore be taken with confidence. All that is necessary in order to carry out the experiment is a dark room in which a candle has been placed. Now take the egg and hold it up between the eye and the light. A new-laid or very fresh egg will show clearly an air space in the larger end between the shell and the lining membrane. If the egg is really new laid this should be very small, for it tends to increase as an egg is kept. All the rest of the surface shown should present a homogeneous and translucent appearance, if the article is positively bad a number of dark spots will be visible. A glance at the accompanying photographs will readily give an idea of the two qualities. Once the test has been performed there is no reason why anyone should ever be taken in over the egg question. There is little doubt that milk, especially in towns, is still subject to the time-worn practice of adulteration with water. If skillfully done this is not very easy to detect if the mere appearance of the liquid is considered. There is one very simple test which will tell us at once whether the milk is of a good quality and rich with a proper amount of cream. Take a sample of the milk and place it aside in a receptacle, a small tube is good for the purpose. Stir the milk well and then take a thick bright knitting needle. Plunge this to a depth of several inches into the milk and hold it steadily slanting downward. If the milk is of a rich quality the fluid will slowly gather in a drop at the end of the needle and this will remain, for rather a long time. On the other hand, supposing water has been added the drop will hardly form at all, and even if it should it will not stay but will quickly fall. Poorly fed cows on occasion will give a milk which is so lacking in cream that it will not pass the test under mention. It cannot, therefore, always be said that the milk has been fraudulently watered, although in any case where the result of the experiment shows a poor article it would be well to change one's milkman.

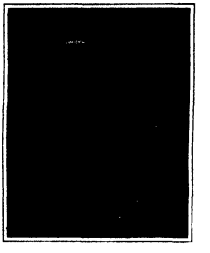
It is idle to deny that there is a great deal of "butter" sold which if it is not margarine, is an indifferent substitute of doubtful composition. Of course, pure margarine, made as it is from vegetable oils, is at any time better than poor quality butter, although there is of course nothing like the genuine article, on nutritive grounds. Happily it is not a difficult matter to distinguish between margarine and all other butter substitutes, and the pure article. The so-called "spoon" test has been commonly employed by analytical chemists for a long while, and is very reliable. A sample of butter two or three times the size of a pea is placed in a large spoon and heated over an alcohol burner, or if this is not available an ordinary lamp or gas burner will do as well. Good fresh butter will boil very quietly, producing a number of small foamy bubbles. On the other hand, margarine and most examples of made-up butter will crackle and splutter, making a noise very similar to that which is caused by the placing of a green stick on a hot fire. Still another point of distinction is to be noted if a portion of the sample be placed in a bottle and this is placed in water warm enough to melt the butter. If this is kept warm for half an hour the fat will either be cloudy or entirely clear. In the former case the material is certainly margarine or at any rate not pure butter; in the latter instance however, the article may be adjudged to be of a high standard of purity and freshness. Some of the cleverly made process-butters which are on the market do not always give very definite results but a little study of the matter will enable the experimenter to judge the extent of the adulteration of which he is the victim.

Of the commonly used breakfast beverages there is little doubt that coffee is the most widely adulterated. Fortunately, again, there are some simple tests by means of which anyone may determine the character of the article which he buys. When the admixture of foreign matter is carelessly done an examination of the grains with a powerful magnifying glass will be sufficient. Absolutely pure coffee should give an entirely uniform appearance, but the presence of adulterants which may take the form of ground peas, beans or a host of other articles is readily observed. Chicory, which of course may have been openly employed is recognized by its dark and gummy grain, this is very

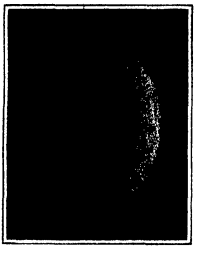
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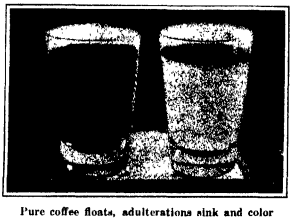
How a bad egg looks in the candle test.



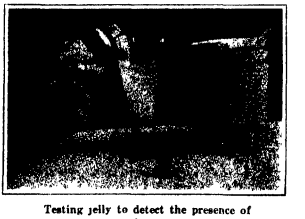
An unsafe package—blown out at the top.



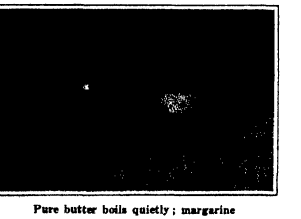
The air space in a new-laid egg.



Pure coffee floats, adulterations sink and color the water.



Testing jelly to detect the presence of glucose.



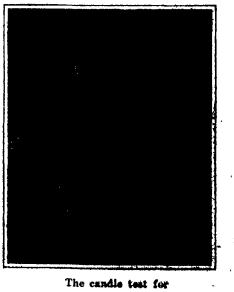
Pure butter boils quietly; margarine sputters.



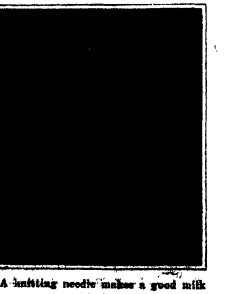
Testing pickles in diluted ammonia to find copper.



If it thickens, the cocoa is adulterated.



The candle test for eggs.



A knitting needle makes a good milk tester.

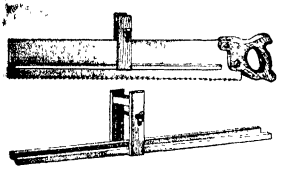
SIMPLE TESTS FOR FOOD PURITY.

Suggestions for the Workshop

Ingenious Expedients of Resourceful Mechanics

Depth Gage for Saws

IT is frequently necessary to make a saw cut of uniform depth, and unless a special device is provided for the purpose the task is an extremely difficult one The accompanying illustration shows a small gage which may be applied to any saw and may be adjusted thereon to prevent the saw from cutting deeper than desired. Two thin strips of wood of about the



Depth gage for saws.

length of the saw blade are fastened to a pair of arms secured to a block at the upper end A thumb screw below this block may be tightened to clamp the two strips against the blade of the saw These strips may be secured at any desired point on the blade, and thus provide an easily adjustable depth gage

A Simple Holder for Files

THE principal difficulty of filing a smooth surface lies in the tendency to rock the file because the handle is located at the end This tendency can be overcome to a large extent by fitting the file with a handle such as here illustrated The handle may be made of a round iron rod, a quarter of an inch in diameter, with the ends heated and flattened, as shown In one of the flattened ends two small holes should be drilled to receive the screws with which the device is secured to a block of oak three-fourths



Holder for flat filing.

inch square and 2½ inches long A hole should be drilled through the center of the wood to receive the shank of the file, and a thumb screw may be used as a set screw, to retain the file in the block The rod may now be bent, as illustrated, to form a convenient handle, with the free flattened end bearing against the file surface

With an arrangement of this sort the pressure of the hand is better equalized and it will be found easier to file a perfectly smooth surface

Scaffold Dogs

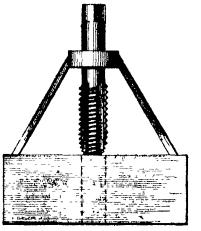
IT is always more difficult to make a scaffold with round timbers than with square timbers, for the reason that there is no solid bearing offered in the former case In order to make the scaffold secure special treatment is required. A simple device for holding two round timbers together is pictured herewith. It consists of a U-shaped piece of round iron, with its free ends bent upward. This U-shaped piece is fitted round the upright timber, while the horizontal timber is supported in the cradle formed by the two ends Before applying the hook, a dog is threaded upon it This dog is provided with a tooth at each end, adapted to dig into the vertical timber and hold the hook at the desired position The greater the weight on the hook the more firmly will the teeth of the dog be embedded into the wood At the same time, the hook may readily be removed when it is desired to take down the scaffold.



Scaffold dogs for round timbers.

A Tapping Guide

THE engraving herewith shows a handy little device for tapping holes straight The hole in the device is made large enough to take a half-inch tap and a bushing may be made to suit the bodies of taps from half inch to one-quarter As soon as the point



Guide for straight tapping.

of the tap has entered the hole the operator can see if the tap is being held square with the work. After the tap has entered the hole far enough to guide itself the guide is removed so that the hole can be tapped out deeper.

Ball-turning Device

By H. D. Chapman

THE ball-turning device illustrated in the accompanying drawings was designed to meet a special order for a large number of ball connections A number of methods of doing the work were tried, but in every case the balls were not perfectly spherical and it was necessary to lap them in their seats The final solution of the difficulty was that shown in the drawings The ball connection *A* (Fig 1) was caught in the lathe chuck. The compound rest of the lathe was removed and a worm wheel substituted This had a

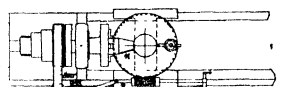


Fig. 1.—Plan view of the ball-turning attachment.

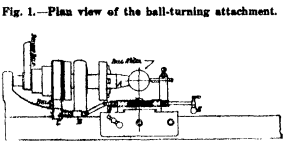


Fig. 2.—Side view showing the tool mounted on the worm wheel.

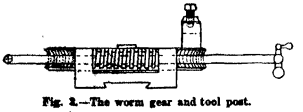


Fig. 3.—The worm gear and tool post.

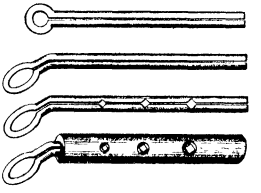
pin in the center, which was fitted to the counterbore of the cross slide. The worm wheel was also supported by means of poles which fitted in a circular T-slot, though not so tightly as to prevent the wheel from revolving upon the center pivot A tool post was mounted on the worm wheel, and in this the tool was carried.

The worm wheel which carried the tool was turned by a worm mounted on a shaft *D*, which was rotated by means of a belt *C* driven from the cone pulley of the lathe The shaft *D* was connected to the pulley shaft by means of universal joints as shown clearly in Figs 1 and 2 After a cut was taken the tool was advanced to a new position by a turn of the handle *E*. The balls turned in this manner were found to be perfectly true

Screw-driver Wrench and Tap Wrench

By G. H. Ander

THE writer is frequently called upon to repair the "reversers" of electric locomotives, and in order to do so it is necessary to remove screws which are so located as to be inaccessible to an ordinary screw driver The screws are locked by denting the edges with a center punch so that they will not readily become unscrewed Furthermore, they are so arranged that there is no way of securing a grip upon them with a small monkey wrench or a Stillson Under these conditions the writer found it necessary to make a special tool from a cotter pin about five or six inches long The eye of the pin was flattened out,



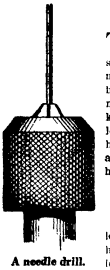
Screw-driver wrench and tap wrench.

so as to receive the blade of a screw driver and the pin was bent to the shape shown in the illustration In order to make the tool of further service, several notches were cut in the adjacent edges of the pin, so as to fit taps of different sizes These notches were made with a file, while the pin was split open for the purpose A quarter inch iron pipe was then fitted over the pin and holes were drilled in the pipe mating the notches in the pin The result was a combination screw driver wrench and tap or reamer wrench The drawing illustrates successive stages in the evolution of the tool

A Needle Drill

By Philip Edelman

THE accompanying figure illustrates a simple way to make small drills Insert a common needle in a small chuck, and file or break off the point. These home-made drills are excellent for all kinds of wood, and will cut thin lead and unglazed porcelain The handy man will welcome them as an aid in starting small screws in hard wood and for many other uses



A needle drill.

Workshop Notes

Solder for Soft Metal.—The following method will be found very handy for soldering soft metal at low temperature Add three drops of mercury to each one-half ounce of solder The solder will then fuse at a low temperature.—H D C

Drilling Compound.—In drilling tool steel such as dies, use a compound made of one pound common soda to four quarts of water, and one quart machine oil Let it stand for about one-half hour, and it will be ready for use.—A C

To Remove a Broken Amber Pipe Stem.—When an amber pipe stem is broken off, the amber part of the stem is very likely to stick in the bone sleeve, and if one attempts to take it out by force the bone sleeve will probably be twisted out of the neck of the pipe To overcome this difficulty, soak the broken stem and sleeve in alcohol This will soften the amber stem slightly, and it can then easily be unscrewed from the sleeve.—H. M Nichols.

The Inventor's Department

Simple Patent Law; Patent Office News; Inventions New and Interesting

An Automatic Mail Exchange System.

FEW if any of the readers of this magazine have failed to notice the crude apparatus in use at our small railway stations by which a single pouch of mail is delivered to a flying train, but it is doubtful whether many realize that this mail exchange system has been the subject of more discussion among government officials, more study upon the part of inventors and the source of greater loss and annoyance to all concerned than almost any other piece of mechanism in the public service.

Since 1880, when the first iron catcher arm was put into commission, practically no improvement has been made in the mail exchange system in use upon our railroads.

Hardly had the mail catcher's arm of 1880 been put into commission than all connected with the service realized its inefficiency. Failure to collect or deliver the mail led to numberless petty quarrels between mail clerks and station employees. Frequently pouches thrown from passing trains or knocked from the cranes were sucked under the wheels of the cars and ground to powder. Worst of all, accidents to engine men and other employees who inadvertently put their heads out of the windows and were struck by the extending arms of the crane became so common that many inventors became interested in the subject. Plans by the hundred were suggested but few departed materially from the old design and all proved a failure when put to the test. Disappointed at their failure, the government retained the use of the former apparatus and accidents to employees and mail continued increasing rapidly as the service was extended.

To-day there are more than 12,000 stations in this country where catcher service is in operation. This service is maintained at enormous expense because of the hand labor involved.

Recently a western traveling man has developed a mail exchange system that is completely automatic. Either the compartment pattern or the full sized mail car, as now used in the railroad mail service, can be equipped with the new exchange system. The car equipment consists of a receiving arm or chute attached to the sides of the car door and folded when not in actual use, so that it extends but two inches from the side of the car. Running upon rollers in a false floor between the doors of the car is a steel delivery truck, capable of handling more than one thousand pounds of mail matter and arranged to dump its contents upon a special platform at an appointed spot along the track. The platform slants away from the track to prevent the pouches from piling up as they are deposited and a low railing surrounds it to overcome the possibility of the pouches rolling under the wheels of the train.

The station equipment consists of from one to twelve steel station cranes as required and one receiving platform as just described. Located at the side of the track, 441 feet from the receiving platform, is a trip which comes into contact with its counterpart upon the mail car as the train passes. A worm gear attached to the middle of one of the axles of the mail car runs a driving shaft provided with a clutch. This clutch throws the mechanism into gear when one of the car trips attached to it comes in contact with the trip located along the side of the trackway as the car passes it. The mechanism makes one revolution and then automatically throws itself out of gear. The first quarter of the revolution rings a gong in the car to notify the mail clerk that an exchange is to be made and opens the car door, the second quarter pushes out the delivery truck until it dumps the mail and opens the receiving chute, the third quarter holds the delivery truck in position while it dumps the mail and the receiving chute in position until the station cranes are passed and the mail upon them is conducted into the car, the fourth quarter pulls the delivery truck back into the car in the position it occupied before the mechanism was tripped, folds the receiving chute into its original position and closes the door of the car. This completes the exchange and the device remains out of gear until again tripped at the next exchange station.

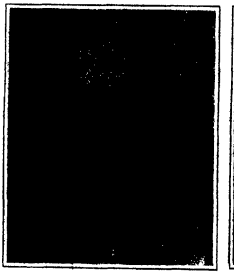
The operation of the mechanism being reduced to an exact mathematical basis, or ratio, where, in a movement of one degree of its revolution equals four feet of travel on the rails by the car wheels, the exchange must be positive. An adjustment is provided to take care of the different sizes of car wheels, wear, etc. Being geared to the axle, the mechanism runs fast, slow, forward or backward as the car runs, and if, for any reason, the car is stopped and backed up after passing the trip, and before the exchange is completed, the mechanism is turned backward with it. When started forward again it would bear the same relation to the car wheels as before. At terminals of the road the device can be quickly reversed and the receiving chutes changed to the opposite side of the door so that it is unnecessary to turn the mail car around for the return trip.

The station equipment is limited to 12 cranes but instead of being obliged to use pouches of a special shape and size as with the present catcher system, pouches and tie sacks, of any weight from an empty to the heaviest in the service, may be used and any class of mail handled in them. The delivery of mail is only limited by the number of mail cars in the train, as each car can deliver upon the platform the full capacity of its delivery truck, as required. All the former danger to engineer or passengers from being struck by the crane arms is eliminated in the new steel cranes which, when set for action, stand 20 inches from the side of the car. The extending arms of the crane are equipped with clamps for holding the pouches and are so protected that the pouches can be inserted into them but one way, which insures the proper operation of the system. When relieved of their burden, the crane arms automatically swing to a parallel position with the track where they remain until set for the next exchange.

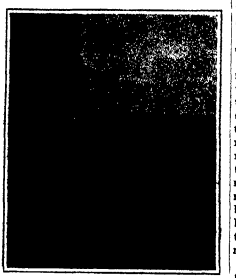
For example, either part of the system may be made to work by itself so that if there is no collection to be made at a station the delivery of the mail only takes place, and *vice versa*. If no exchange whatever is to take place the mail clerk merely throws the mechanism out of gear with a lever. Human memory is sometimes tricky, however, and the mail clerk may forget to throw the mechanism out of gear before the station is reached. The gong rings and the device begins to operate. The mail clerk upon being reminded of his mistake, quickly throws the reversing lever and the mechanism runs backward and throws itself out of gear.

Accommodations have also been made for the turning of the trucks on sharp curves by the use of knuckle and slip joints, so as not to interfere with the operation of the device, and the parts beneath the floor of the car are protected from injury by water, ice and snow or from flying stones and gravel of the roadbed.

This mail exchange system has been tested hundreds of times at Overland Park, Kan., a suburb of Kansas City, in the past year. Exchanges averaging 450 pounds of mail on each trip have taken place at speeds varying from 5 to 40 miles an hour. Not one failure of the device has occurred nor a single damage to pouches or equipment thus far, and as a result of exhibitions of its operation, made in the presence of government officials, permission has been granted by the Post Office Department to use the automatic exchange for handling mail to test its practicability in the regular service. It now remains for each individual road to relieve itself of the expense, delay and danger to its employees which are inherent qualities of the present mail exchange system.



Mail being taken from the station cranes.



The truck delivering mail at a station.



A battery of station cranes loaded with mail.



Exchange of mail with a passing train.

George Washington on Rumsey's Steamboat

ONE of the earliest contests involving priority of an invention was the contest of James Rumsey to the claim of John Fitch to the steamboat invention and Mr. Rumsey had no less a witness in his behalf than George Washington, who, in an indorsement forming a part of the records of the case, says

"I have seen the model of Mr Rumsey's boat, constructed to work against stream, examined the powers upon which it acts, been eye-witness to an actual experiment in running water of some rapidity, and give it as my opinion (although I had little faith before) that he has discovered the art of working boats by mechanism and small manual assistance against rapid currents; that this discovery is of vast importance, may be of greatest usefulness in our inland navigation; and if it succeeds, of which I have no doubt, that the value of it is greatly enhanced by the simplicity of the works, which, when seen and explained, may be executed by the most common mechanic.

"Given under my hand at the town of Bath, County of Berkeley, in the state of Virginia, this 7th of September, 1784.

"GEORGE WASHINGTON."

Priest's Invention of a Fire Extinguisher

INTERESTING accounts are received from abroad concerning tests of a fire extinguisher understood to be the invention of a priest who has been decorated by

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the French Government. In describing the invention in a report published by the Bureau of Manufactures, Consul-General Griffiths of London, says:

"Two cylinders are used, one of which is small and charged with 'ignifuge' gases which by connecting tubes are used to expel the solution from a much larger cylinder through an ordinary nozzle. The compound is described as follows:

"1. A mixture of ignifuge gases, which, as a physical agent, utilizes its elastic force to project a liquid impregnated with salts and as a chemical agent renders the gases of the atmosphere which burn in every fire incombustible.

"2. An effervescent liquid, in which are found salts in a state of solution. These salts, unknown before, were obtained by the Abbe D. Daney through electric furnaces of 3,000 to 5,000 amperes. When projected they produce other extinguishing gases which increase the effect of the ignifuge gases referred to above. When reaching the blazing material they cover it with a peculiar dustlike coat, which makes it fireproof."

Notes for Inventors

False Prophets.—In the face of the enormous increase in the issue of patents from year to year, it is recalled that forty years or more ago an examiner in the division of agricultural implements of the Patent Office announced dogmatically that plows had been perfected and that no more patents would be granted for plows. About the same time an attorney engaged in soliciting patents declared his intention of going out of the business since about everything had been patented that could be.

A Laminated Rail-joint.—In a patent (No. 1,005,146) John A. Bodkin of New York city shows a splice bar forming the fish plate of a rail-joint and composed of a series of long, thin plates lying side by side and increasing gradually in width throughout the series so that their edges may coincide with one another and also with the outer edges of the base and ball of the rail.

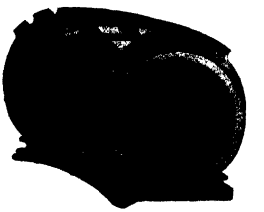
Another Safety Device for Aeronauts.—A safety device, patented (No. 1,005,569) by Auld Weinberg De Meir of Providence, R. I., takes the form of a garment whose body portion is provided with exterior air chambers. The air chambers are arranged in superposed rows extending around the garment and open at the bottom and have a vent at the top and are adapted to perform the function of a parachute.

A Reversible Glove.—A reversible glove, which has oppositely disposed inserts, one of which forms the back of one finger and the other the front of another finger, is shown in patent (No. 1,005,437) granted to Charles H. Leavengood of Coshocton, Ohio, assignor of one-half to John A. Hesket of the same place.

A Dressing for Felt Hats.—Large fortunes have been made out of dressings and polishes for men's shoes. The men who wear shoes also wear hats, and these are oftener discarded because they lose their color than because of wear. Will not some one invent a dressing, it may be in the form of a dye, easily applied to a hat, and serving to freshen it up and improve its appearance? Possibly the dressing would have to be applied in some original way, but this can, doubtless, be devised by one experienced in the manipulation of felts, and it should be of such a character as to be easily and effectually handled by the ordinary wearer.

A Safety Apparatus for Mines.—The mine safety apparatus, provided in patent No. 1,005,196, to Maturen Gold of Hayward, Okla., and William A. Montgomery of Leland, N. M., provides a system of pipes in a mine and provided at intervals with taps, a blower for forcing air through the pipes and a helmet with an air vent and with air inlet pipes with couplings which may be connected with the taps of the main pipes. The apparatus also includes a water pipe provided with means for distributing water at different points within the mine.

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RECENTLY PATENTED INVENTIONS.

Interesting items are open to all patentees. The notices are inserted by special arrangement with the inventors. Terms on application to the Advertising Department of the SCIENTIFIC AMERICAN

Of General Interest.

PARASOL AND UMBRELLA COVER—J. W Lewis, 124 Lower Terrace, San Francisco, Cal The object here is to provide an umbrella, parasol or like article with interchangeable covers, so that with a single frame a number of covers with different color or material may be used, and so that the life of the umbrella may be prolonged indefinitely by replacing the covers when worn

ASH HOLDER FOR CIGARS —Charles F Hodgin, 524 Chemical Block, Spokane, Wash The object of the invention is to provide what may be termed a clip-cap safety cigar smoker, and the intention is to provide a cap adapted to fit and be self retaining on the burning end



ASH HOLDER FOR CIGARS

of a cigar and to retain the ashes and prevent the same from falling while the cigar is being smoked or held in the hand The safety cap is foraminous to afford passage of air and is preferably made with a screen body of fine mesh wire or other material in the form of a cone and the inner or butt end of the cap is adapted to grip inwardly upon a cigar. A perspective view of the invention is shown in the engraving

Electrical Devices.

ELECTRIC ELEVATOR BRAKE —Volney W Mason, Providence, R I The larger illustration shows the application of the brake to the right and left driving shaft of the electric motor on which are two worms, which mesh into two worm gears on the hoisting drum shafts On the extreme left is the square frame supporting the rheostat for varying the strength of the electric starter The driving shaft is coupled directly to the motor shaft by a flanged coupling which also forms a brake pulley The brake arms are suspended at their upper ends from a stud supported upon an inverted V-shaped frame rigidly attached to the base block The brake arms extend downward below the brake pulley in a straight line, in which are longitudinal slots The transverse horizontal operating brake lever is pivoted to a stud stand in the space between end portions of the brake arms as shown in the small illustration, and carries friction rollers on the two stud bolts shown on each side of the central stand, which are free to move vertically within the slots. The left end of the lever is attached to the lower end of a solenoid operating vertically within an electro-magnet, the latter being shown with its connecting wires to the right of the hoisting drum in the large illustration In the diagram view the operating lever is shown drawn up by the solenoid of the electro mag net in this position while the current is on, which holds the brake arms as well as their brake surfaces apart away from the brake pulley. When the operator in the elevator breaks the circuit by the usual switch the solenoid drops also the operating lever by its weight and an adjustable weight attached thereto, bringing the lever into an inclined position (shown by the dotted line) which causes the brake arms to clamp the brake pulley and stop movement of the motor shaft as well as that of the elevator The general construction of the frame (in the large engraving) embodies means of adjustment not usually found in machinery of this class all the parts being very accessible and convenient in erection or removal in case of repairs

Hardware and Tools.

PLATE LIFTER —Joseph E Wenman, New Philadelphia Ohio The accompanying picture represents the plate lifter in a perspective view The invention relates to a form of lifter or detachable handle for articles, especially those which are too hot to be readily handled without the interposition of some such tool The object is to provide a utensil having

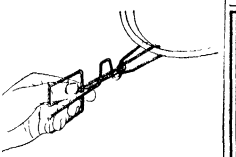


PLATE LIFTER.

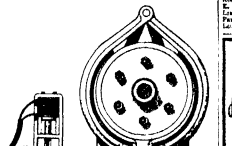
parts, which may readily be constructed from metal wire without the use of any connecting pivots The relative parts are so constructed that they may be readily and removably locked in position In the construction each member is made continuous of one length of wire, and there are no drilled joints.

FISH GRIP—J Buttman, 180 Hamburg Avenue, Brooklyn, New York In this patent the object of the inventor is to provide a fish grip for the use of fishermen fish dealers and other persons, and arranged to permit of obtaining a firm hold on a live fish when taking it off the fish hook, or out of a net or for holding a fish for scaling, cleaning or other purposes

Machines and Mechanical Devices.

RULE CUTTING MACHINE J A Brenaris, Albion, Mich This machine is adapted for cutting bent rules as well as straight ones When a bent rule is to be cut, the shelf or gag bar, which serves as a support for straight rules while being cut is raised and swung back out of the way, which allows due access to the cutting mechanism so that the bent rule may be manipulated in the required manner

NOTE. Copies of any of these patents will be furnished in the SCIENTIFIC AMERICAN for ten cents each Please state the name of the patentee, title of the invention, and date of this paper



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Notes and Queries.

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(12561) W S B writes: In re "Musical Sands"—SUPPLEMENT, September 30th, p. 224—a good specimen exists at Manchester, Mass., where the sand of the beach near the hotel creaks audibly when walked on A Very true; and there used to be a sounding beach between Rockport and Gloucester, Mass., when we used to summer on that coast The waves raised the pebbles and smaller stones, and as they fell back they gave a musical tone by their rapid blows against each other

(12562) A. F. K asks. 1 How much by weight and what number and kind (single or double covered) of platinum wire will be necessary for one induction coil such as is used for pump spark ignition on gasoline engines? A For the primary of an induction coil giving an inch spark use about 50 feet of No 14, B & S single cotton-covered magnet wire Double-covered wire may be used with some advantage in insulation, but a loss from the increased space taken up by the wire 2 How much and what number and kind of secondary wire is necessary for the same coil? A The secondary may contain 1¼ pounds of No 36 wire Silk-covered wire makes the smaller coil, but cotton-covered wire is stronger mechanically 3. Is a condenser generally used with such coils? A A condenser is necessary You will find all details for making coils, machinery for winding, etc., described and figured in our Collins's "Making of Induction Coils," price $1. Nearly every one making a coil should have at hand

(12563) C M asks In one of your older issues I saw how to make a luminous lamp I tried it, but it will not work I heated pure olive oil for fifteen minutes in a small glass bottle, put in a piece of phosphorus and corked it up, but it gives off no light at all The phosphorus shake to the bottom of the glass Can you tell me what is wrong? A If you will take the cork out of the luminous bottle and shake the contents in the dark, so as to have some air from the outside enter the bottle, you will see the phosphorus that the oil has dissolved any of the phosphorus The oil will not shine unless some oxygen from the air can get at the phosphorus We have had one of these for years which still shines whenever we shake it up and bring fresh air into contact with the phosphorus

(12564) J. T P asks Can you tell if directions for making a pinhole camera have ever appeared in your publication? If so, to what number, and at what price can I get this copy? I wish to make an 8 x 10 camera Have a book already, telling how to make an apparatus to take 4 x 5 plates This says make pinhole with No 10 needle Now tell me this At what distance from pinhole should an 8 x 10 plate be, and what size needle should I make the pinhole with? Also, what is the length of exposure for clear sky, hazy sky? A In the pinhole camera the size of the plate is not directly connected with the size of the hole at all. The distance of the plate from the hole for best definition is determined by the size of the hole. We give you a table from a French writer on this subject

Aperture.	Distance of Plate
0 012 inch	4.33 inches
0 016 inch	7.87 inches
0 02 inch	11.8 inches
0 024 inch	17.32 inches

The pinhole should be perfectly round, and carefully bevoled on both sides, as perfect as it can be made, if you would get best effect It will include about 170 degrees If then you secure a wide view at a distance of 8 inches with the aperture 0 016 inch, and wish a view giving a detail of some part of this wider view, you have only to move the plate back to 17 32 inches and use the 0 024 pinhole The same width of view is taken in by the pinhole in both cases, but at the longer distance only a small portion of the view will fall on the same sized plate. The result is an enlarged view of a portion of the former picture A wide range of the time of exposure is possible with skill in managing the development With the smallest pinhole given, the exposure will be at least twenty-five times longer than with a lens giving the same size of picture, and with the longer distances the exposure must be greatly increased in length, probably two hundred times for the 17.32-inch distance You will have to work these matters out for yourself by experiment. The light is very faint when spread over a large plate, when the aperture is only 1/40 inch at the largest.

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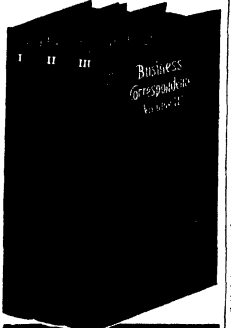
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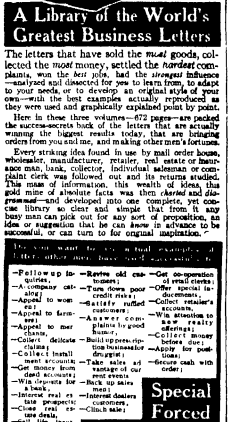


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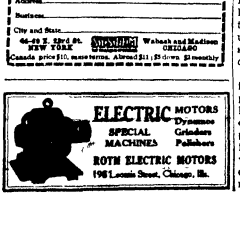
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[The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.]

A "Mars" Visitor

To the Editor of SCIENTIFIC AMERICAN:

I shall be infinitely obliged and highly thankful to you if you will kindly take on yourself the trouble to inform me at an early date as to the truth and accuracy of the following incident said to have occurred in Mexico, which has excited the amazement of the people in this quarter of the globe, especially in the absence of any mention of it in your world-renowned paper, the SCIENTIFIC AMERICAN, which I have been an interested reader of; nor do I find any such reliable authority to be referred to on the topic

The local papers here describe the descent of a man from Mars accompanied with a clap of thunder and lightning which put all the people of the locality to flight with the single exception of a scientist, who alone had the courage to proceed to the scene of the occurrence to satisfy his curiosity, and he is said to have described the man to be twenty cubits long, his speech being above the book of the scientist At last, the man, as is said, after a short stay, flew away Here I request you to throw some light on the subject which will bring us from the realm of uncertainty to that of truth

Your paper has proved very valuable to me Almost all its articles are intrinsically interesting, opening to me a broad field of scientific knowledge It reveals to me a museum of rare objects of curiosity and wonder. I should also thank you warmly if you would inform me through your columns how far the progress of the astronomers has, in counting stars, till now gone

I have much to talk about and many things to converse upon, but the long distance stands in the way, as the postage (which comes to the engineering office and from which source I see it) takes a month to reach the office

ABRAR BAKSHI

Cuttack, Bengal, India

[The key to this extraordinary letter from our far-away correspondent will probably occur to those of our readers who may have chanced to be in the locality when "Bud" Mars, the aviator, made his recent flight into Mexico. With this incident in mind, and allowing for the errors of hearsay and translation of Mexican vernacular into Hindoo, we can see how "the local" papers came to "describe the descent of a man (from the) Mars," etc. To the Mexican countryman who probably never even have heard of, much less seen, an aeroplane, the descent out of the heavens of this apparition (with its engine back-firing and shooting out flame and thunder claps) may well have suggested the supernatural. In some such fashion, doubtless, were founded and perpetrated many of the myths of ancient Greece and Rome.—ED.]

Safety Devices in the Cab

To the Editor of SCIENTIFIC AMERICAN:

I was glad to see in your issue of October 7th the very clear and forcible statement of J B Wells in opposition to the proposed safety stop locomotive throttle Two possible solutions of the problem present themselves

What happens when a man suddenly loses consciousness from any cause? He collapses. Must we not look to this fact for our solution of the question? It is quite possible to require an engineer to perform his regular duties standing within a light, semi-circular guard His collapse in any direction would immediately throw a considerable pressure upon the upper rail of this guard, which would result in the operation of levers shutting off the engine and applying the brakes

Or perhaps a preferable mode of achieving the same desirable end is by a footplate upon which the engineer stands. His collapse would remove all, or in any event most, of the pressure from this plate This is infinitely better than having the pressure at the throttle and brake valve handle, and leaves the hands of the engineer free to perform any duties he may find necessary. Any difficulties presenting themselves may, I am convinced, be met and mastered with comparative ease.

Bridgeport, Conn. ARTHUR POWELL.

The Battleship "Orion"

(Concluded from page 481.)

cent" (21.9) and the "Superb" (21.63); while the four completed battle-cruisers, designed for 25 knots, have all made well over 27 knots.

Principal interest in the new ship naturally centers in her armament First of all as to its disposition: and here it is to be noted that the British Admiralty has been slowly working round for some years toward the consistent American principle of the all-center-line arrangement, which is, after all, as essential to the ideal dreadnought as unity of caliber. The second turret from aft, which in previous ships is on the same level as the aftermost, was raised so that the aftermost turret could be brought up under its guns. There is a general impression that the object of this arrangement was to increase the astern fire, but that is not so. The primary object was to save length; and although the special trials which the "Neptune" carried out in the Mediterranean showed that the superposed guns could be fired directly astern if needed, they also showed that such a maneuver was not at all advisable. In the case of the "Orion," no attempt has yet been made to fire more than two guns (those of the first and fifth turrets) forward or aft, nor is it likely to be.

So far as the arrangement of the turrets is concerned, the new ship has no exact counterpart in any fleet. She most nearly resembles the "Delaware" class, with, however, the following difference: In each case there are two turrets forward and three aft of the superstructure; but instead of the third turret from aft being raised to have further astern as in the "Delaware" class, the "Orion" has the second (or middle) turret so raised. In other words, the forward turret arrangement is repeated astern, and a fifth turret is placed just abaft of the superstructure, on the same level as the aftermost.

Each turret contains two 13.5-inch guns, of whose ballistics little is known outside the gunnery circles of the fleet itself The weight of the gun, usually placed at 80 tons, is 76 tons, and its length is 45 calibers, while the weight of the projectile is 1,250 pounds. The muzzle energy, firing with full charges, is believed to be 60,000 or 70,000 foot-tons (as compared with 53,400 foot-tons for the latest 12-inch model in the British service); and the perforations of 26 inches of Krupp cemented steel at 3,000 and of 22 inches at 5,000 yards (with capped armor-piercing shot in each case) are believed to be reliable but must be accepted with reserve For purposes of comparison it may be stated that the 13.5-inch guns mounted in the obsolete battleships of the "Royal Sovereign" class (now being sold out of the service) are 30 calibers in length, weigh 67 tons, and fire a 1,250-pound shell with a muzzle energy of 38,230 foot-tons, or just about half the power of the new weapon. The penetration of the old gun (Krupp steel) at 3,000 yards is 11 inches

The following table shows the increase in the size and power of successive types of British all-big-gun ships:

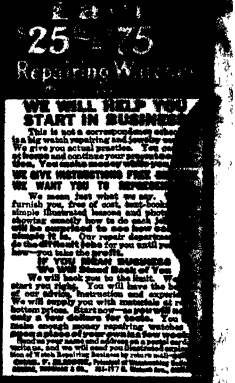
Completed.	Type Ship.	Length Feet.	Tons.	Broadside. Pounds.
1906	"Dreadnought"	490	17,900	6,800
1909	"Bellerophon"	490	18,800	6,800
1910	"St. Vincent"	500	19,250	6,800
1911	"Hercules"	510	20,000	8,500
1911	"Orion"	545	22,500	12,500

The anti-torpedo armament of the "Orion" consists of twenty 4-inch 31-pounder rapid-fire guns, mounted in two groups, each of ten guns, disposed as shown in the illustrations. In the firing of the heavy guns several of the mountings of the smaller weapons were started, and so seriously that it is understood some new arrangement for them will be found.

The following sister ships to the "Orion" are approaching completion:

"Thunderer," "Conqueror," "Monarch," to be completed by March 31st, 1912. "King George V.," "Centurion," "Ajax," "Audacious," to be completed by January 16th, 1913.

The last four will be slightly larger—about 24,000 tons—due to better protec-

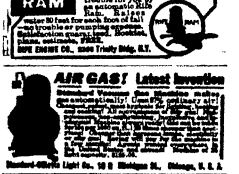


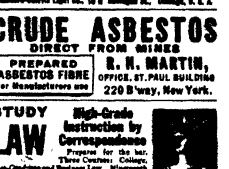


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Simple Tests for Food Purity

(Concluded from page 428.)

...rmful if it is present in large quanti... Further, nearly all the adulterants ...powered present a shiny appearance. ...arnish coffee always looks somewhat ...ill. A more rapid way of testing any ...kind of ground coffee is that pictured in ...n accompanying illustration. Take a ...tumbler of water nearly full to the brim, and scatter about half a teaspoonful of the grains upon the surface of the liquid. Pure coffee contains a large amount of oil and on this account the grains will float with a very few exceptions. Practically all the adulterants in use will sink to the bottom of the tumbler. The presence of chicory in the sample is at once known by the almost instant coloring of the water a deep brown shade. If the tinting is very intense chicory has been added to a positively unwholesome extent. Pure coffee grains will not color cold water, at any rate not until the passing of a considerable interval. In these experiments it is interesting to include a few samples of the so-called coffee substitutes, many of which will be shown to contain a large amount of coffee, and this in spite of the assertions of the manufacturers.

The only means by which illicit additions to tea can be detected is by an examination of the dried leaves after one has become fully acquainted with the genuine article. Leaves of many kinds of plants have been employed in this connection, of which those of the wild plum are perhaps the most commonly used. Nowadays, however, at the place of its production tea is so cheap that it scarcely will pay the manufacturer to do much in the way of adulteration. Cocoa is rather different, however, and there is little doubt that huge quantities of this substance are sadly behind what they should be in the way of quality. Some form or other of starch is a very favorite adulterant with certain sections of the trade. This may be at once detected if about a teaspoonful of the powder is placed in a cup and boiling water is added. If any starch is present the liquid shows a very marked thickening, a happening which should not be noticeable to any extent in the genuine cocoa essence. A much more harmful adulterant is the addition of cocoa shell, unfortunately the presence of this is not very easily discovered save by the help of a microscope. If the powder has been unreasonably ground it may impart a slight grittiness to the mixture, though of course the skilful manufacturer will take great pains to avoid this.

There are perhaps no articles of food which are more commonly adulterated than jams and jellies. It is not an exaggeration to say that very little of the material sold of this nature is simply the fruit named on the label embodied with pure sugar. Most of the adulterants, such as those used for coloring and adding to the bulk of the jam, are fairly harmless, though none is of course desirable. Starch is a very common adulterant in jam though owing to the cloudy properties which it would give to a clear jelly it cannot be used with much effect in this article. In the case of jam it is impossible to detect its presence without a small test. Dissolve a teaspoonful of jam in half a teacupful of hot water. Through a piece of muslin strain away any solid matter which is left. Now add drop by drop a solution of potassium permanganate until the mixture is practically decolorized. In some cases of artificially colored jams the decolorization may not be very complete, but this can hardly affect the final stages of the test. When the liquid has quite cooled down add a single drop of tincture of iodine, and if any starch is present the solution will turn a decided blue color. Even more commonly used than starch is glucose, and to determine the presence of this adulterant a slightly different test is necessary. Again the same quantity of jam or jelly should be dissolved in warm water, in the former instance it will be necessary to strain away the insoluble matter as before. Now allow the solution to become quite cool and then add an equal amount or possibly a little more of strong alcohol. In order that the subsequent stages may be closely observed it is as well to carry out the experiment in a glass vessel. If the sample is a pure fruit one there is very little precipitation except perhaps the smallest amount of proteid bodies. On the other hand should glucose have been employed in the manufacture a cloud of dense whiteness separates from the rest of the solution, and finally settles down at the bottom of the tumbler. This may be taken as conclusive evidence that glucose has been used as an adulterant.

In order to render the appearance of the pickles more attractive copper, to a greater or less extent, is frequently employed in the preparation of pickles. This may not have been directly added in every case, for the practice of boiling the pickles in copper jars is quite sufficient to account for its presence. Scalding vinegar has a powerful effect upon copper a fact that should be noted by every cook. Even when only present to a small extent this mineral is highly injurious as of course it is a rank poison. Pickles of a very bright green color should always be suspected and put through the following test. Mash some of the material with a fork until it is well crushed, and then place the material in a stoppered bottle. Add to this a solution composed of ammonia and water in equal parts and shake the whole well. If there should be the smallest trace of copper the ammonia turns a blue color. Copper is often used to deepen the green of imported canned goods such as peas, beans, spinach, etc. In some articles of this nature it has been found to a really alarming extent. A very interesting experiment to detect its presence is one involving the use of hydrochloric acid, a strong corrosive which of course must be used with extreme care and kept away from contact with the skin or clothes. Still the test is so curious that many people will be interested to try it. Mash a sample of the vegetables and place a teaspoonful in a teacup, add thirty drops of hydrochloric acid. Set the cup on the stove in a saucepan containing boiling water, drop a bright wire nail into the cup and keep the whole thing boiling for twenty minutes. Stir the mixture all the time with a splinter of wood. At the end of the time stated drag out the nail, when if copper has been used with the vegetables, the article will be found to be heavily plated with that metal.

A final word on the subject of canned goods may not be out of place. These are used so widely nowadays that the laws controlling their preparation are rightly stringent. Still now and again, for no very clear reason something goes wrong with a tin of goods. This is almost always shown by an alteration in the external appearance of the package. The top or the bottom appears more or less "blown out" and when this is the case even to a small extent the contents should be unhesitatingly condemned. There is always grave risk attending the consumption of articles contained in unsightly tins.

Major John Burger Waring

MAJOR JOHN BURGER WARING, brother of Col. George E. Waring, died on October 30th at the age of seventy-seven. Major Waring was well known as a pioneer steel pen maker. The two types of pens invented by him were named the Chase medallion and the Washington medallion. During the civil war he invented an improved device for spiking cannon. Enlisting as a lieutenant in the Fourth Missouri Cavalry, he attained the rank of major in the Ordnance Division. After the war he invented an apparatus for removing silk from the cocoon, also a rock drill and many other mechanical devices. All told he secured over seventy patents.

IN 1909, 65,399,889 barrels of cement were produced in the United States, valued at $52,797,973. In 1900 the production was only 17,231,150 barrels. In 1905 it was 31,675,357 barrels, in 1906 it was 51,060,445 barrels, and in 1908 it was 52,810,935 barrels.



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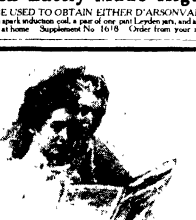
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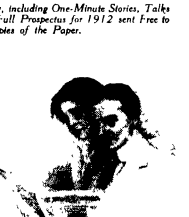
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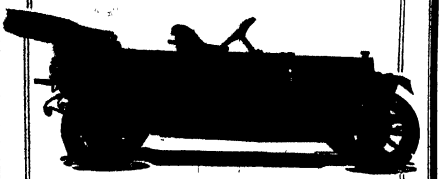
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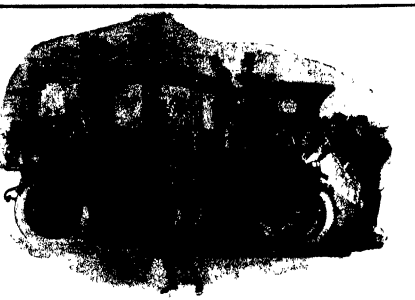
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Hupmobile

You can thank the insistence of the motor-buying public for this new Hupmobile Roadster

Newspaper reports of the impressive performances of the World-Touring Hupmobile have had a three-fold effect

They have stimulated, everywhere, the always extraordinary demand for the Hupmobile Touring Car and the Hupmobile Runabout.

And, in addition, they have given rise to a new demand, which has voiced itself in a persistent call, from all parts of the country, for a Hupmobile Roadster with the same chassis and the longer wheelbase of the globe-girdling car

The achievements of the World-Touring Car—which is winning new honors at this writing in far-off lochs—have fired the public imagination, and advocates of the roadster, everywhere, have urged our dealers to give them a Hupmobile of that type

So, here you have it—a Roadster with the specifications which have proven so marvelously efficient in the 25,000 miles of land travel credited to the Hupmobile Touring Car since it left Detroit last November, and the thousands of touring cars in use in all parts of the world

Having its two seats midway between front and rear axles, and with the flexible springs and long wheelbase of the touring car, the Roadster is a particularly easy-riding car

Thus it is especially fitted for road work

Its power plant and other mechanical features are identical with those which have given the Hupmobile its high reputation and durability, long life and efficiency—and you can see for yourself that it is one of the most beautiful members of the notable Hupmobile line.

The tool box on the rear deck can be removed, affording an extra large carrying space for the individual requirements of owners for touring or for commercial purposes

We have issued a new portfolio picturing the trip of the World Touring Car, with views of Australia, New Zealand, India, the Philippines, Korea, Japan and other countries, which it has accomplished. A copy of this will be sent free to any address on receipt of Burton Holmes or Frank Carpenter. Call the coupon and secure a copy of this fine volume, which is now ready.



HUPP MOTOR CAR CO., 1233 Jefferson Ave., Detroit, Mich.

THE HUPMOBILE WORLD-TOUR

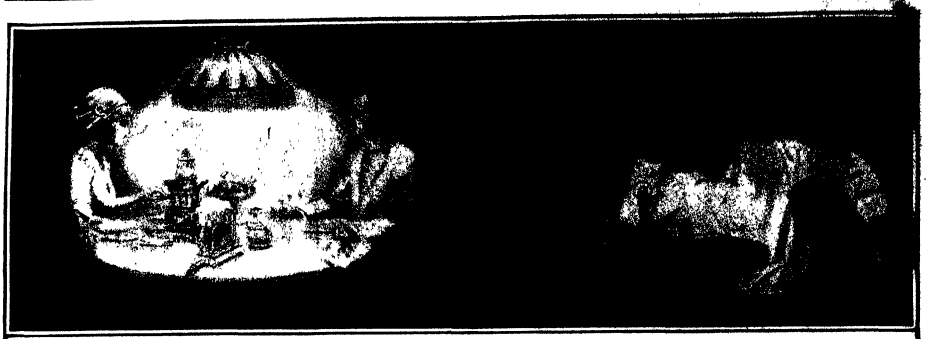
The World-Touring Automobile left Detroit last November ¶ It is now in India ¶ It has traveled some 25,000 miles on land, under its own power ¶ It has crossed the United States; toured the Hawaiian Islands, and climbed to the smoking crater of the Volcano Kilauea ¶ It has penetrated the Philippine wilderness, going where no other car has ever ventured, it has climbed the steepest mountain slopes of Australia and New Zealand ¶ It was one of the very first cars to attempt an extended tour of mountainous Japan ¶ It has gone into China ¶ No other car has ever attempted a trip of the severity or duration of this tour ¶ Before the Hupmobile's return to Detroit early in 1912, it will have visited North Africa and Europe and toured the continent of Europe ¶ Many pictures, showing some of the difficulties from which the Hupmobile has emerged triumphant, are contained in the portfolio covering the Oriental section of the tour.

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The Great Inventor's Prophetic Vision

Thirty-two years ago, when Edison invented the incandescent electric lamp, he saw, in his dream of the future, every home equipped with electric service. He foresaw, thirty-two years ago, that the ideal home of the future would include not only electric lighting, but also electric cooking and heating.

His dream "electric-light-for-everybody" has come true for those who will read and heed. The Edison Mazda lamp with its non-fragile filament, made from a drawn wire stronger than steel, brings electric lighting within everybody's reach. This lamp gives three times the light of the ordinary carbon filament lamp using the same current.

The carbon filament lamp was good; the tungsten lamp was better, but the sturdy Edison Mazda lamp is the last word in lighting because it combines durability with the highest efficiency known.

But perfected lighting is only one economical advance in electricity. Electric cooking has come.

The new metal-alloy "Calorite" has been perfected by the General Electric Company. The high temperature necessary for electric cooking causes other metals to oxidize and break down. But here "Calorite" is indestructible.

You can now get an electric flatiron, radiant bread toaster, coffee percolator or a complete electric kitchen range—durable, satisfying and economical.

So the prophetic vision of Edison, the great inventor, has come home for all of us. The wonderful new Edison Mazda lamp and the indestructible "Calorite" are ready for you today in your home town.

Step into the electric light Company's office or an electric supply dealer's anywhere. Ask to see Edison Mazda lamps and the G-E heating and cooking devices. If they cannot show them to you write our nearest office for complete information.



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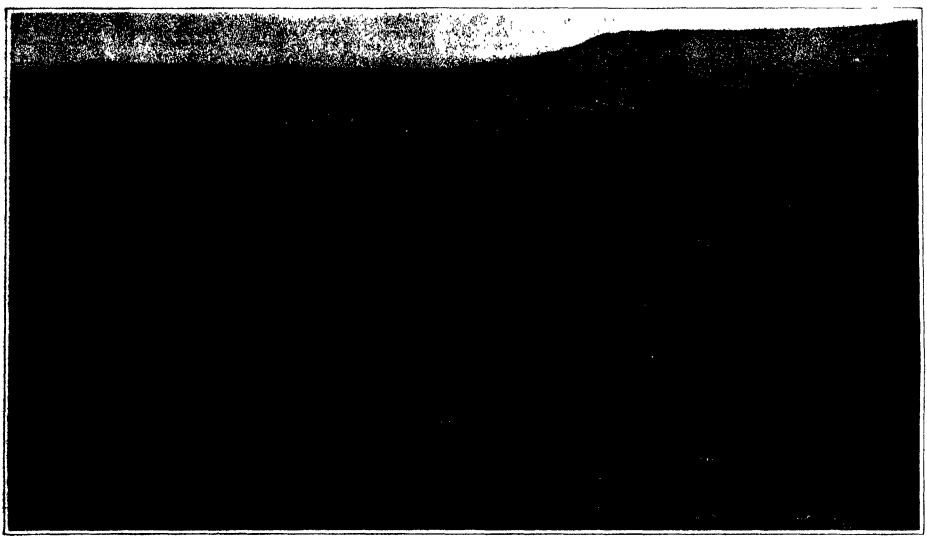
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THE WEEKLY JOURNAL OF PRACTICAL INFORMATION

VOLUME CV. NUMBER 21.] NEW YORK, NOVEMBER 18, 1911 [15 CENTS $3.00 A YEAR



Looking South from a fork in the road. Canyon City in the distance.

The "Sky-Line Drive"

A Road Along the Crest of a Limestone Ridge

By J. Mayne Baltimore

CANYON CITY, in Colorado, has one of the most remarkable driveways in the world. For certain features there is none other which can be compared with this magnificent drive, so unique is the whole affair.

The "Sky-Line Drive" as it is appropriately named, lies along the very crest of a long and lofty limestone ridge that rises from 800 to 1,000 feet above the surrounding plain on both sides. These limestone ridges are a characteristic feature of the region, and are called "hog-backs." This particular "hog-back" extends west and north of Canyon City, its top forming a long sky-line, and making the horizon in that direction.

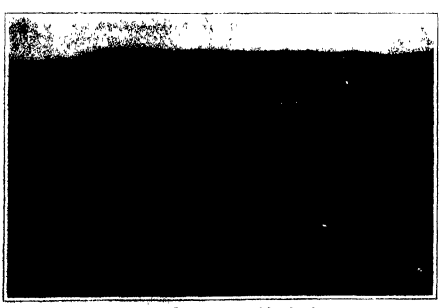
Travelers traversing this remarkable "Sky-Line Road" may be seen many miles away—boldly silhouetted against the sky. The remarkably clear atmosphere of the Colorado country renders it possible to secure the smallest details—even glimpses of the sky between the spoke of the wheels, and under the horses. This famous "Sky-Line Drive" affords a most magnificent view. Canyon City lies clear out, far below the traveler, and one may look down upon it, as if looking on a colossal relief map, and almost as if poised above it in an airship.

The drive is about 25 feet wide, on an average, and it winds to and fro, and sweeps gently up and down on the narrow crest for about four miles. For the greater part of this distance the travelers are more than 900 feet above the city and the surrounding plains, to which, on both sides, the walls of the "hog-back" drop almost perpendicularly.

The beauty of the panoramic view on the other side—beyond Canyon City—is magnificent. Here valley and winding river, foot hills and mountains, have combined to form a marvelous scene filled with loveliness and grandeur.

The drive was constructed by convict labor, that made it possible to carry out such an extensive improvement. All the credit for the construction of the road properly belongs to John Cleghorn, warden of the Colorado State's Prison.

John Cleghorn, ever busy minded and far seeing conceived the idea of making of this rocky impenetrable, and dangerous ridge, a driveway. Going to Canyon City, he laid the matter before the more public-spirited citizens of that place. Of course, he had the convicts—"boys" he called them and the labor would be furnished free to the people, but it took money to pay for the necessary powder, tools, etc., and Mr. Cleghorn could not furnish any money. In less than forty-eight hours the necessary finances were provided, and Cleghorn put large gangs of convict laborers at work immediately. It took a long time to "hew out" the road. Many problems were encountered but the work was finally completed.



A magnificent view on either hand.

To-day there stands a large monument on the highest point of the road on which are carved the simple words "John Cleghorn, Sky-Line Drive." This great roadway is a public highway—absolutely free to all—pedestrians, equestrians, and every kind of vehicle, including automobiles. The driveway is one of the leading attractions of Colorado, and its accomplishment besides adding to the grand total of road improvements in the west, serves as a rich example of how means, hardly thought existing, may be used to carry out a large and a successful undertaking.

SCIENTIFIC AMERICAN

Founded 1845

NEW YORK, SATURDAY, NOVEMBER 18, 1911

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The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are sharp, the articles short, and the facts authentic, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

The purpose of this journal is to record accurately, simply, and interestingly, the world's progress in scientific knowledge and industrial achievement.

The Navy and the Inventor

IT IS a notorious fact that the inventor who approaches certain of the government departments in the hope that his invention will be investigated without prejudice and, if found meritorious, bought up at a price which will guarantee the inventor in selling his invention with the right to exclusive use, will find that he has a hard road to travel. More often than not he will experience unnecessary delays, to say nothing of considerable financial loss and ultimate disappointment.

An eloquent plea for a more liberal attitude to the inventor is made by that able officer and inventor, Rear Admiral Bradley A. Fiske, U. S. N., in the September issue of the *United States Naval Institute Proceedings*. The argument is so well put that we cannot do better than give it in the Admiral's own words. He points out that it is the duty of the navy to encourage not merely engineering skill and mechanical ingenuity, but real invention. "Knowing the brilliant original inventive genius of our countrymen, we must not stop short of a determined effort to 'ascend the highest heaven of invention.' We must hold as high an ideal in this matter as we do in the matters of strategy, tactics and engineering.

"Such a policy, wisely and energetically carried out, will have as direct and beneficial effect on the navy as our admirable patent system has on the country at large. But, to carry it out, we must first treat inventors as sane and reputable men, and recognize the fact that not only does an attempt to evade plain patent rights seem to inventors dishonorable, but it turns them to fields where they have more chance than in a battle against the government.

"Why inventors should be treated as they have been is not quite clear. Certainly it has been neither wise nor right to humiliate a class of men who have been useful in the past, and can be made useful in the future. Certainly it is not right for a great government to violate its own patent laws, and infringe patents which the government itself granted and for which it received $55 each.

"Does anyone deny that our electric lights, torpedoes, guns and engines were invented before they were developed, that they were conceived before they grew and waxed into maturity? Does anyone deny that, but for inventors, the coal and iron and brass of our ships would still be in the bowels of the earth? We all know that ideas are what have breathed the breath of life into material brass and iron. *It has already been possible for one invention to increase the hitting power of naval guns at least ten times.* Why not develop such things as soon as possible in secret and secure the military advantages accruing instead of resisting them until all the world knows about them, and then buying tremendously secret about details that any intelligent mechanic can vary in a dozen ways?"

Patent Property. What It Is. Its Protection

A UNITED STATES patent in terms purports to grant to the patentee "the exclusive right to make, use and vend" the invention therein set forth during the term expressed in the grant throughout the United States and its territorial possessions.

The wording of this grant is misleading, for the government cannot grant to anyone, any right exclusive or otherwise, to make, to use, or to sell an invention which in any way trespasses upon the prior rights of others. A patent is only *prima facie* evidence of the right to exclude others from making, using or vending the invention, and it is always open to the infringer to show that the patent is invalid, by reason of the absence of novelty, utility or invention in the patented device, or because of other statutory defenses.

Many patentees seem to have the impression that the government should of its own initiative compel the alleged infringer to cease his infringing acts. But because the patent is only *prima facie* valid, the government cannot act until proof is offered showing its validity, and for the same reason the infringer refuses to stop his infringing acts.

Having once, however, proven to the satisfaction of the courts of the government, that the patent is good and valid, protection will be at once afforded to preserve the rights of exclusion bestowed upon the patentee by its grant. This result, however, is attained in the great majority of patent suits only after the expenditure of considerable money, and the expiration of months and sometimes years of time. The owner of a patent, believing his rights to be infringed, if he decides to proceed against the infringer, files a bill in equity, the great majority of patent suits being brought on the equity side of the court. In this bill, he charges the alleged infringer with the infringement of his patent. The infringer thereupon becomes a defendant, and either denies that he has committed any act of infringement, or admitting that he has, he justifies his acts by pleading that the patent is invalid, and oftentimes combines in one answer both of these offenses.

It is not often that an infringer is discovered making the thing identically as shown, described and claimed in the patent, and the question whether the thing which he does make, constitutes an infringement, thereupon becomes an issue. Occasionally, it will be found that the infringing device is identical with that of the patent, and in such cases, the validity of the patent will constitute the issue. In this attack upon the validity of the patent, it may be shown that the invention was not new at the date of the patent, that it was not the invention of the patentee, or that it had been in public use and on sale more than two years prior to the date of the application on which the patent was issued.

The preparation of and presentation to the court of the evidence on behalf of the patentee, and the alleged infringer, is what involves the extraordinary expense incident to patent suits. The decision in such cases generally rests upon the testimony of experts. Those who testify for the patentee, explain to the court the construction, organization and mode of operation of the invention of the patent, and comparing the same with the thing or things made by the alleged infringer, and express their opinion as to whether or not such things embody the patented invention. The experts for the alleged infringer thereupon place their interpretation upon the patent at issue, and upon such other and prior patents, both domestic and foreign, which may be relied upon as showing either that the patent in suit is of restricted scope, and not infringed by the defendant's manufacture, or is completely lacking in novelty and invention. This evidence is taken before an examiner, and the cost in the average case approximates $175 per day. A further expense arises from the necessity of printing the evidence for presentation to the court. This entails an expense of from $1 to $1.25 per printed page. The expense may be greatly increased by the introduction of irrelevant and immaterial testimony, and also the placing upon the record of extended and oftentimes unwarranted objections of counsel, all of which must be taken down by the examiner and presented to the court, for under the present rules he cannot pass upon the admissibility of evidence.

It has been stated that the cost of taking the testimony and presenting it to the court in the famous Selden case, was upward of $150,000. In that case, after long years of litigation, while the patent was not invalidated, the defendants ultimately escaped the charge of infringement. Fortunately for the owners of that patent, however, it was *prima facie* of such a formidable character, that long before the final adjudication, they had succeeded in collecting from the manufacturers of automobiles, thousands of dollars as royalties. The brief in the Selden case consisted of two large octavo volumes of at least 500 pages each, and could have been produced only at considerable cost.

Another famous case, wherein the city of New York was sued, for infringing a patent covering an automatic relief valve for fire engines, was fought through the courts for a period of twenty years, from final adjudication, an estimated cost of half a million dollars, and was finally decided in favor of the city on the ground that the patent was invalid, the invention having been proven to have been in public use two years and eleven days before the patent was applied for.

The right of exclusion, however, which the government bestows upon a patentee, and which costs so much to enforce, has proven in many cases to be an extremely valuable right; has enriched many inventors, and constitutes the foundation of vast business enterprises, and to this right, largely, is due the wonderful progress of the civilized world.

Build a New Patent Office

THIS is not the age of sentiment or conservatism. A costly new building twenty stories high, for example, must be demolished to make room for one forty stories high which will yield a correspondingly higher profit.

The SCIENTIFIC AMERICAN has repeatedly called attention to the urgent necessity for a newer and greater Patent Office. An article was recently printed giving the facts about the over-crowded and obsolete building now occupied by the Commissioner of Patents and his force of one thousand subordinates. This article was prepared for the purpose of showing the inventors of the country and the manufacturers and merchants that they have been woefully negligent in not insisting that Congress take some steps to house the Patent Office decently. Their negligence, however, has been nothing to that of Congress itself, for the inventors, manufacturers and merchants cannot acquaint themselves at first hand with the conditions at Washington without considerable loss of time and money, while Congress, on the other hand, has been repeatedly and persistently importuned in the matter, and every member of Congress is in a position to thoroughly satisfy himself on the subject.

Ever since Commissioner Moore first took the office he now holds he has been reminding Congress that the Patent Office is in need of legislative action to give it larger and better working quarters. Bills have been introduced carrying the necessary appropriations and arguments have been made in the committees, all to no avail.

The surprising thing about this dilatory policy on the part of Congress is the fact that the Patent Office, which is one of the very few self-supporting branches of the government, has a sufficient surplus in the Treasury to defray all the expenses of a new Patent Office building, including the ground to build it on. This surplus, which amounts to something like seven millions of dollars, represents a net profit over all the expenses of running the Patent Office since it was first instituted. A pretty comfortable margin of profit, indeed, when one considers the enormous expenses that the office is under to get competent examiners and to turn out high-grade printing, photolithographing, etc. What private enterprise whose net profits were seven millions of dollars would be content to occupy a building wholly inadequate for its needs?

Congress has no right to require clerks to work in dark, crowded rooms, where health is endangered and ambition thwarted. Disagreeable surroundings have a physical and mental effect on workers. Ask any housewife whether she can work or live happily in an untidy house. In such a household one would look for disease, sloth and uncleanliness. Is it not equally discouraging for men and women to work in a room where documents and books are piled high, accumulating dust, and in a semi-chaotic condition, just because there is no room for them to be properly cared for?

Congress does not have to appropriate a single dollar for the building of a new Patent Office over and above the surplus already earned by that bureau. A bill should be passed early in the coming session giving relief to the Patent Office. Every session that sees nothing done in this regard increases the gravity of the situation. The Patent Office records are of the utmost value. Their loss or destruction would undermine the foundations of the entire business world. They could never be replaced. The security of countless millions of dollars rests in their preservation. The Patent Office models, too, lead a precarious existence, and some effort should be made to give them proper storage facilities until such a time as they can be properly housed in the new Patent Office.

Some day when it is too late, perhaps Congress will be forced by the clamor of public opinion to allow the use of the Patent Office's money for a new building. Why not take action now, while there is yet time to save these priceless records?

Edison's Impressions of European Industries

[That the powers of observation and analysis, which have contributed so largely to Mr. Edison's success, were used to good effect during his recent lengthy tour of Europe, is evident from the following "impressions" which were given, during a recent interview, to a representative of the SCIENTIFIC AMERICAN *—ED.]*

Q. WHAT feature of the industrial situation in Europe has made the deepest impression on your mind, Mr. Edison? Ans. I am free to say that among the countries which I traversed, Germany has left by far the deepest impression on my mind, particularly as regards the enormous strides which she is making in the development of her industries and the extension of her foreign trade.

Q. What do you consider to be the fundamental secrets of Germany's success? Ans. Her intelligence, her patience, her industry, and her appreciation of the value of co-operation. In the development of their industries and commerce, the Germans are a united people. They are working upon a carefully co-ordinated plan, having for its ultimate object the capturing of the major portion of the world's commerce, and in this effort they have the great advantage over other countries, and particularly over the United States, that they have back of them the assistance and prestige of the German Government.

Q. What is the German attitude toward the inventor? Ans. I find that the inventor has better opportunities in Germany than he has in the United States, and this for the reason that any factory which manufactures articles of the character covered by his invention is encouraged to take hold of it, because of the financial assistance which it can secure from the great promoting banks, of which the Deutsche Bank, one of the largest in the world, is the most notable example. If an inventor brings a new invention to a factory, he is not likely to be turned down because the company is without the necessary capital to cover the cost of its manufacture and exploitation. They can present the invention for the consideration of a corps of engineers and auditors, which is maintained for that special purpose by the Deutsche Bank, and if they pass favorably upon the invention and upon the standing of the manufacturing company, the company will be financed to such an extent as the bank may think proper. Now we have no such promoting banks in this country. The inventor must either endeavor to interest the manufacturer by personal application, or he has to fall back upon the professional promoter, who too often is quite unreliable.

Q. To what extent does the German Government stand back of the patents which it grants? Ans. Although the German Government does not guarantee the validity of the patent, it practically arrives at the same result by making it a very difficult matter to obtain a patent. In the first place, the invention must be quite meritorious. The inventor will have a long fight in the Patent Office, in which the question of its priority will be most carefully investigated. But when he once obtains his patent, it is a patent, and after a certain number of years it cannot be disputed. The German patent possesses the greatest value, and if an American inventor has a really meritorious invention, I would advise him to fight the German Patent Office to the very last ditch. If his invention possesses distinct merit he will be treated fairly and will get his patent. Before leaving the subject of patents, I may say that I do not think the corporations follow the practice of buying up patents simply to pigeon-hole them, and I do not believe that this is done in the United States as much as some people imagine.

Q. Have they a "trust" problem in Germany? Ans. Regarding German business methods, particularly among the corporations, I find that though they do not have "trusts," as we understand the term, in Germany, they have what is practically the same thing. They have pools or cartels, which set the price that all the people, or a portion of the people, as the case may be, engaged in any industry, shall ask for their goods. They have a central agency; but over this the Government exercises no supervision, and indeed, it does not prevent the formation of these pools, realizing that destructive competition will never build up German trade. Take note, however, that these cartels do not strangle the small man. They take him in, or, if not, do not close the door of equal opportunity.

Q. To what extent is American machinery used in Germany? Ans. Every American manufacturer who visits Germany will be at once impressed with the widespread and increasing use which is being made by the Germans of American machinery—machinery either of American make or American design. When they take American designs as their models, they make very little, if any, improvement therein. Their labor costs very much less than ours, and therefore there is not the same incentive to design automatic machinery, and, very wisely, they leave this particular field to the Americans. When we have improved our machinery, they come over and buy it, and after they have tried it out and found it to be satisfactory, they duplicate it. It would be foolish for the Germans to go ahead and try a lot of experiments in making automatic machinery, when they know that the Americans are bound to do it anyway, and do it better than they can. Undoubtedly, Germany has benefited enormously from the introduction of American tools and American methods, but the debt is not altogether on their side. Germany is a great scientific nation, continually engaged in scientific research, and as the result of this, we not only get from her a large number of scientific discoveries which we apply to our industries, but she also furnishes us with an enormous amount of chemicals for use in our various industries. The German, on account of his patience and other valuable peculiarities, is well equipped for the task of working out tedious and involved processes—something which the average American takes to very unkindly. The American wants quick results. He is forever striving to cut down the time element, and hence, as I have already stated, he is pre-eminent in the field of automatic machinery. But for the task of developing intricate processes, involving much time and extraordinary patience—processes which, as in chemistry, involve many unknown reactions—the German is wonderfully well qualified.

Q. Does German superiority extend beyond the chemical industries? Ans. It must not be thought that German advance is restricted to the field of the chemical industries. Not only is she already pre-eminent here, but she is threatening our supremacy in many other branches of manufacture. The danger for us lies largely in the raw methods of interference by the Government and the weighting down of business with cumbersome and little-understood laws, some of which are enforced and others not. Furthermore, while political interests in Germany are universally friendly to trade and commerce, in this country politics is one of the heaviest burdens that industry and commerce have to carry. Here in America we have no mercantile marine to carry our goods, and, even if we had, we possess no banking facilities in outside countries to assist the exporter in selling the goods. We have no corps of young men specially educated to go out to foreign countries and hustle for business. A large and rapidly increasing part of the products which I saw in course of manufacture and being shipped from German factories was not for use in Germany, but in countries outside of its borders. Unless business in the United States is put on a more satisfactory basis, and is rid of the present interference by the politician, Germany will be in such a strong relative position that she will win out against us right down the line.

Q. Do you think the German dream of commercial supremacy will be realized in the near future? Ans. Personally, I do not believe that Germany will attain pre-eminence in the commerce of the world as rapidly as some people think. To-day, Great Britain is the leading nation in manufacture, engineering, and shipping, with all that this implies. She has an enormous, well co-ordinated and harmonious empire, and at present she has the great advantage that she holds the leading position in finance. Germany does not hesitate to let the world know that she aims at the high position now being held by the English people as the leading commercial nation, and in the race for supremacy she is going, just now, very much faster than any other country. She is giving England a great run, and, judging from present conditions in the two countries, it looks as though in time she should reach the goal—but not just yet.

Q. Do you see any signs of decadence in Great Britain? Ans. I do not think that the English nation is decadent. Far from it. But I do consider that there are conditions in the English industries which, unless they can be changed, must lead to commercial decadence. I refer to the very serious question of her union troubles. In Germany I saw a man working three planers; I understand that in England the unions will not permit such a thing to be done. All through the German shops, any man will work as many tools as possible. All the factory operatives are on piece work. This, I believe, is not permitted in England. Hence the Germans can manufacture goods of the same quality as the English very much more cheaply; export them in their own ships, and finance the sale of them over a long period—and I can see but one ending to a competition of this character. Furthermore, the English business man does not come as early to his work, and he leaves it earlier than does the German.

Q. This great increase in the German navy—does it mean war? Ans. I do not believe that this commercial rivalry between the two nations will lead to war. Emperor William is a pretty good business man, and he would be very foolish, now that German commerce is spreading so rapidly over the world and German ships are found upon every trade route, not to take the proper measures to insure these enormously valuable and growing interests. The best insurance for a large foreign trade is a navy adequate to its defence. I do not think that the Emperor and his people are building the big German navy with any express intention of fighting England or any other nation. Germany in building her navy, has simply given notice to the world that she is a big manufacturing nation and that she is going to find a market for her goods in every corner of the earth. Therefore, she is going to see to it that no more countries shall be shut up against her commerce. This, of course, is making Germany unpopular, but I cannot see that her attitude is anything but perfectly reasonable and proper.

Q. While in Germany did you look into the matter of municipal government? Ans. I wish to pay tribute to the high state of perfection to which they have carried their system of municipal government. In the first place, they appoint a very high-class man for mayor, and he holds this distinguished and greatly honored position for life, or until such time as he is retired. One direct result is that these mayors are all the time trying to better the government of their cities, to bring in new industries, and to improve them artistically and otherwise. I had the pleasure of meeting six or eight of the mayors of different German cities. They were certainly the very finest type of men. Most of them spoke English without any accent whatever, which greatly surprised me. Furthermore, their knowledge of engineering was of quite a high character. I could not learn that there was any graft whatever in any of these German cities.

I have spoken of the artistic improvement of the German cities. The same spirit is observable in France, and generally in such European cities as I visited. Ugly or unsightly buildings or freak buildings of any character whatsoever are not allowed to go up. They carry this principle to such an extent that in Paris where they have a great many double-deck buses run by gasolene, an order was recently promulgated that after a certain date no more double-deck buses must be used in Paris, for the reason that they were inartistic in appearance. It was understood of course, that the double-deck buses were more profitable, but Paris would not permit the corporation to earn its greater dividends at the expense of the general artistic appearance of the streets, although the city, I understand, is a partner in the enterprise.

Q. Naturally the lighting of European cities interested you, Mr. Edison. What did you observe? Ans. Speaking of the conditions in the cities, I noted that the lighting of the leading European cities does not compare with that of New York. Berlin and Paris are about equally well lighted, but Berlin is continually putting in more light, and before long she will greatly surpass Paris in this regard. Night life in Berlin is increasing very rapidly. It was observable that throughout Europe the night life is on the increase in those cities which have cheap water power, and there seems to be a correlation between the night life and the industrial activity of the people. In towns where the people have cheap and plentiful light, they keep later hours, and this seems to have the effect of mitigating the phlegmatic character of their temperament. In Switzerland, for instance, I have seen two towns which were of the same size and generally alike in their conditions, with the exception that one, possessing suitable water power, was well lighted at night, and the people of this town instead of going to bed at eight o'clock, were on the streets up to ten or even later. This town had decidedly a smarter appearance. More buildings were going up and there was a general air of enterprise. Many people sleep too long and over-sleeping, contrary to commonly accepted ideas, so far from being refreshing, renders one sluggish and slothful. Hard work, work in which you are thoroughly interested, is more stimulating and refreshing than sleep for sleep's sake.

For thirty years I slept only four hours a day and I have had lots of assistants at various times that did the same thing. We all felt fine.

Needed Reforms in Patent Procedure

By Melville Church

WHILE our patent system has commanded the admiration of the world and has had many imitators, it is certainly susceptible of much improvement, as any one familiar with the details of its workings will testify.

The delays and expense involved in securing a patent, against the opposition of an adverse claimant, the enormous cost and delay involved in attempting to enforce a patent when granted, and the lack of conclusiveness of the judgment finally secured, save in the particular jurisdiction in which it is rendered, call loudly for reforms in procedure.

Under the law, as it now stands, if an applicant for a patent encounters in the Patent Office a rival claimant to the same invention, a proceeding is instituted, known as an interference, for the purpose of determining the question of priority of invention as between the two claimants

Opportunity is given each claimant to adduce evidence in support of his claim and, when the evidence is all in, the case is first argued and submitted to an officer, known as the Examiner of Interferences, for determination The Examiner of Interferences reads the record of testimony (which, by the way, is apt to contain much irrelevant and immaterial matter because of the uncontrolled way in which it is permitted to be taken) and, after from two to four months' delay, renders a decision awarding priority to one or the other of the parties, and fixes a limit of appeal from his decision Within such limit, which is never less than twenty days, the unsuccessful party may appeal to the Board of Examiners-in-Chief, a tribunal of three judges This Board sets a day of hearing one or two months distant and, on that day, there is another argument and submission

After a period of from two to six months, the Board renders its decision and sets a limit of appeal of not less than twenty days The party unsuccessful on the last appeal may then appeal to the Commissioner of Patents, in person If he does so a day of hearing will be fixed from one to two months distant, when there will be another argument and submission Within a period varying from one to four months, the Commissioner will hand down his decision and the party aggrieved thereby may, within forty days of the entry of the judgment give notice of appeal to the Court of Appeals of the District of Columbia, and, within forty days after said notice, may docket his appeal in such Court of Appeals The last named court is a tribunal of three judges, sitting in Washington, and bearing the same relation to the Supreme Court of the District of Columbia and to the Patent Office that the United States Circuit Court of Appeals for any one of the nine judicial circuits bears to the Circuit Courts of that circuit

If the appeal to this Court of Appeals is, for instance, docketed in May, it cannot be heard for six months, or till the November term following When the court hears the appeal taken to it and hands down its decision, it might be thought that the controversy would be settled but this is not the case The decision of the Court of Appeals is not final as to any question litigated before it and the unsuccessful party has still the right, under the provisions of Section 4915 of the Revised Statutes, to file a bill in equity against his so far successful rival, in the judicial district in which the latter may be found, asserting anew his claims to priority In this bill in equity proceeding the plaintiff is entitled to make an entirely new record of testimony and may again call all the witnesses he called in the Patent Office proceeding and as many more as he can find, with, of course, the privilege of the defendant to do the like It will take the better part of a year to get this equity case ready for hearing and, after it is heard the Circuit Court will probably hold it from two to six months before deciding it The defeated party may then appeal as a matter of right, to the United States Circuit Court of Appeals for that particular judicial circuit, at any time within six months of the entry of the decree in the Circuit Court.

After the docketing of this last appeal it may take six months more before the appeal is heard and several months more may elapse before the appellate court hands down its decision finally setting the question of priority at rest.

It will be seen from the foregoing recital that a priority contest may involve the taking of testimony in the initial Patent Office interference proceeding, a first hearing and judgment by a tribunal consisting of one person, a review of that judgment by a tribunal of three, a further review by a tribunal of one, and a still further review by a court tribunal of three, all upon the same record, followed by a further review, on an enlarged or an entirely new record, by another trial court and a final review by another appellate court

Even if the judgment of all the tribunals to which the controversy is submitted be in favor of the same applicant, still, before the final judgment is arrived at, he must submit to being dragged through this long and devious course of litigation, at ruinous expense, before his right of priority can be said to be firmly established.

There is absolutely no necessity for such protracted litigation. The inordinate number of appeals permitted serves no useful purpose whatever The submission of the controversy to a single tribunal of first instance in the Patent Office, with the allowance of one appeal to an appellate tribunal outside of the Patent Office—the Court of Appeals of the District of Columbia, for instance—with power in that court to make a judgment that shall be final and conclusive, as between the parties and those claiming under them, as to every matter involved in the litigation, would seem to be a complete and satisfactory solution of the problem and tend to the furtherance of the cause of justice

There is no more reason for providing a long series of tribunals to try out an applicant's right to priority of invention over a rival claimant than there is for determining, in the same way, any other matter of private right.

A claimant to a piece of land containing a gold mine brings his action of ejectment in a Circuit Court of the United States (the requisite diversity of citizenship existing) against the person in possession, and, if judgment goes against him, he may, by writ of error, remove the case to the United States Circuit Court of Appeals for that circuit, and if the judgment below is there affirmed, the litigation ends.

But, under existing law, an applicant for a patent may contest with another a claim to priority of invention not through two only, but through six different tribunals.

The right to invoke the aid of so many tribunals works a hardship upon both the inventor and upon the public. Experience has shown that the final judgment reached after submission of a case to two tribunals is as liable to be correct as that reached after submission of the same case to six different tribunals.

An inventor enamored of the value and importance of his invention will, of course, pursue his claim through as many tribunals as the law provides, or until his money gives out, but it is no real kindness to him to afford so many additional outlets for his enthusiasm. On the other hand, it would seem to be contrary to public policy that the judicial machinery of the government should be susceptible of being put into motion so many times for the protection of this particular kind of private right.

The first great reform our patent system needs is, therefore, the cutting down of the number of appeals in priority cases.

But the trials of an inventor by no means end when, after undergoing the delay and expense consequent upon the vast number of appeals provided, he at last secures his patent If his ancient adversary, who has contested his right while he was getting a patent, shall continue to practise the patented invention, he must, under the present state of the law, bring a new suit against him for the purpose of stopping him This usually takes the form of a suit on the equity side of a Circuit Court of the United States, in which he asks for an injunction and an accounting of profits and damages. In such a suit, the defendant may challenge the novelty and utility of the patented invention, the identity of his appliance with that covered by the patent—though it may be the same appliance that was involved in the prior interference proceeding—and about the only thing he may not do is to again assert his claims to priority of invention.

When this suit in equity is, by the pleadings, brought to an issue, time is given for the taking of testimony by the plaintiff and defendant, respectively. The witnesses examined are not produced in open court before the judge, so that the latter may observe their demeanor while testifying, and pass upon the competency, relevancy or materiality of the testimony offered, and generally control the proceedings, but, as in the Patent Office proceeding, the testimony is introduced in the form of depositions taken before notaries public, or standing or special examiners of the court, who have no power whatever to pass upon the competency, relevancy or materiality of the evidence offered, or otherwise to control the proceedings, but who simply act as recording officers, taking down everything that is offered by way of testimony, as well as the objections and arguments and irrelevant remarks of counsel, and returning all to the court for the latter's examination. Because of this lack of restraint in the production of evidence, the depositions are extended and long drawn out, some of them, especially the depositions of experts, continuing for weeks and even months, until the record, as one of the federal judges has said, looks as though it were afflicted with elephantiasis.

When it is remembered that good patent lawyers charge from twenty-five to one hundred dollars a day for their services and that good experts charge fifty

(Continued on page 464.)



The enormous record of the Selden case.

"The evidence on the subject of operativeness is the most flagrant example of unsupervised testifying I have ever seen or heard of Whether in 1906 Exhibit 47 was any better than scrap, whether Exhibit 89 would start on flame ignition, whether Exhibit 132 showed diagrams revealing volume or pressure constant, were perhaps interesting, but unimportant questions They raised a false issue, over which months of time and volumes of print have been expended" (Judge Hough, in the Selden case)



Campbell vs. the Mayor, etc., of the City of New York.

This suit on the Knibbs patent for a fire engine relief valve was filed originally in 1877. The patent was sustained in the lower court and a master's hearing ordered This photograph relates to the master's hearing On the extreme right sits Judge Joseph M. Duel, now Judge of General Sessions Court, New York, the master appointed by the court Next is Samuel R Betts, counsel for the defendant, Harvey Hadlock and Mr Wood (both now dead) of counsel for complainant, Mr Washburn, executor of the estate of the complainant. The books forming the background are the entire records of the New York Fire Department at that time, secured by *subpœna duces tecum*, and stacked up to form background. The legal proceedings continued over a period of twenty years.

The French Competition for Military Aeroplanes

Some of the Leading Machines and Tests They Successfully Fulfilled

ALTHOUGH the United States was the first government to purchase an aeroplane for military use, the much more rapid development of the heavier-than-air machine in France led to a quick appreciation of its possibilities for scouting above both land and sea, and the government promptly offered generous prizes this year for the fastest military aeroplane which should fulfill certain conditions. These were that the aeroplanes should transport a total useful load of 660 pounds (made up of 3 men, supplies, etc.) at the rate of at least 37½ miles an hour without a stop throughout a distance of 186 miles. Only machines which were not eliminated in the strenuous preliminary tests were eligible to compete in the final race. To the constructor of the winning machine was to be awarded a prize of $20,000 and an order for ten similar machines at a price of $8,000 each.

The preliminary tests consisted of about a half-dozen flights from the aerodrome at Rheims to certain specified points where the machines were obliged to land upon meadows, stubble and plowed fields, and to start therefrom again, each time carrying a full load of 660 pounds. There was also a "climbing" test in which they were compelled to ascend to a height of 500 meters (1,640 feet) in 10 minutes, while carrying a full load.

In addition to the successful carrying out of these various tests, the following hints were given as to what was desirable:

That the observer's field of vision should not be interfered with by any part of the machine.

That double control should be fitted, or, at least that the pilot should be capable of being relieved by his assistant while in flight.

That machines should be capable of starting without outside assistance.

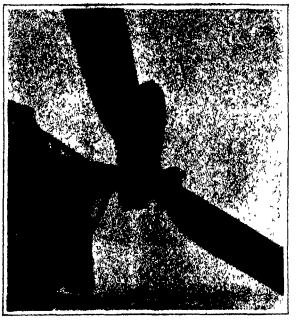
This competition has undoubtedly had a decided effect in stimulating invention and the perfecting of machines. For example, two triplanes made their debut in it, whereas both the Farman brothers brought out biplanes with offset upper planes—a system originated in France by Goupy about a year ago, and which has also been used by Mathew B. Sellers in this country with his multiple-surface, low-powered fliers. The planes have a better lifting effect when they are offset in this way. Henry Farman also entered a biplane the upper surface of which extended beyond the lower one at each end, having a spread of 67 feet.

Instead of obtaining the increased lift necessary by increasing the surface or offsetting the planes, most of the monoplanes effected this by increased power, although the wings were generally somewhat larger than usual. The Nieuport monoplane is shown in one of our illustrations, while another gives a rear view of the novel "armored" Antoinette. This machine was described fully in our last issue. It is the first monoplane constructed and flown successfully with rigid wings without guys, a construction indicated by us in the SCIENTIFIC AMERICAN of October 22nd, 1910. The Nieuport monoplane is noteworthy as being the fastest aeroplane in the world. Its wide blunt body, completely covered with cloth, slips through the air with a minimum of resistance. The machine is shown fitted with a four-bladed propeller, which seemed to be the vogue in this contest. Another aeroplane to use this type of propeller, which long ago was shown in Maxim's experiments to be not so efficient as a two-bladed one having the same blade area, was the Breguet biplane. The body portion of one of these novel machines is shown being towed behind an automobile. They are far simpler in construction than any other biplane, and can be quickly put together or taken apart. Complete details of the chassis will be found in SUPPLEMENT No. 1873. A photograph showing a Breguet biplane being assembled was published in SUPPLEMENT No. 1867. One of the latest inventions of M. Louis Breguet is the propeller with pivoted blades shown herewith. The advantage of this mounting lies in the fact that the propeller blades can adjust themselves to vary the pitch. When starting, the normal pitch is too flat, but by having the blades hinged they will swing forward automatically in proportion to the resistance offered by the air, thereby altering the pitch and thus accommodating themselves to the varying requirements.

Thirty-three machines were entered in the contest altogether, but some of these failed to materialize, so that there were actually but 28. Of these 19 monoplanes and 18 biplanes; 3 monoplanes and 5 biplanes were selected for the final speed test on November 4th. The results of this test are not available at the present writing, but it is probable that the prize went to the Nieuport monoplane piloted by the American Weymann. This machine surprised everybody by the success with which it landed and restarted from plowed fields and rough ground. Its central skid and flat leaf spring connecting the two wheels worked exceedingly well under these trying conditions.

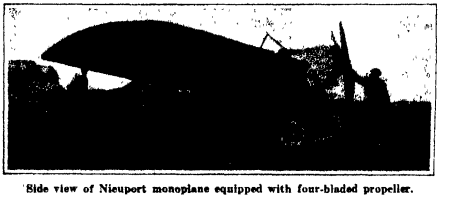
There were three fatal accidents incidental to the carrying out of these tests. One occurred on the ground, a mechanic being struck by a rapidly revolving propeller and sustaining injuries from which he died. Lieut. Conneau, the winner of all the big circuit races last summer, also had a bad fall in his Blériot and broke his legs. René Level fell in his Savary biplane and was killed as a result of engine failure. He struck some wires in a forced descent of 500 feet and his spine was broken in two places. Jean Desparmet, pilot of a 140-horse-power Blériot monoplane, was the third man to lose his life, and the thirteenth military aviator whom France has lost. He was flying splendidly in perfect weather, when his monoplane suddenly dived to the ground from a considerable height.

When we consider that France has over 200 military aeroplanes, and that numerous flights are made daily by her military men, the number of fatal accidents is not so great as might be expected. The military aviators take great risks to demonstrate the practicability of the aeroplane in all kinds of weather, and many of these, for their daring and courage, have received the Cross of the Legion of Honor.



The Breguet triple-bladed flexible propeller.

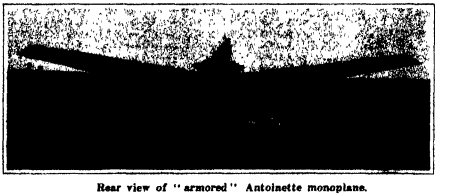
One blade is shown pulled forward. This flexibility prevents breakage of the blades, in turning, owing to gyroscopic force.



Side view of Nieuport monoplane equipped with four-bladed propeller.

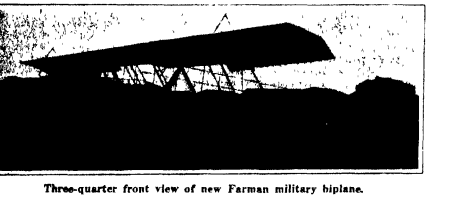


Body of a Breguet biplane towed behind an automobile.



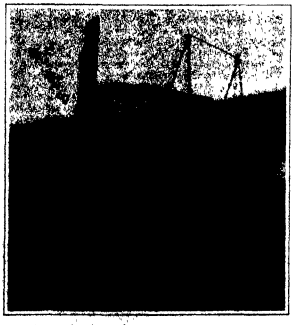
Rear view of "armored" Antoinette monoplane.

This machine is noteworthy on account of the complete lack of guys above and below the wings.



Three-quarter front view of new Farman military biplane.

Note the offset planes and the inclined fuselage projecting out in front. Behind M. Henry Farman there are two seats in tandem for passengers.



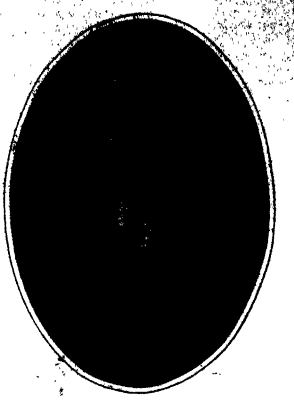
Front of latest Blériot military monoplane.

Note the "Normale" propeller and triple wheels as well as the fairplane winglet in the side of the body.

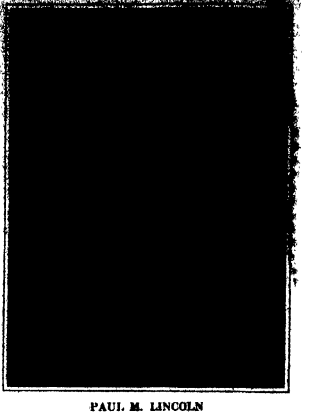
THE FRENCH COMPETITION FOR MILITARY AEROPLANES



CHARLES F. SCOTT
Discovered the phase-transformer.



JAMES W. GAYLEY
Developed the dry-blast process for steel furnaces.



PAUL M. LINCOLN
Invented a synchronizer.

The Industrial Corporation and the Inventor

EVERYONE who has been intimately connected with any large manufacturing companies, especially those manufacturing machines such as lathes, planers and other tools, will recall the activities of certain *attaches* of the companies who were recognized as employed for the specific purpose of suggesting and devising improvements in the machines These inventors spent many hours daily in the shops seeking here and there the improvements which might place the machines produced by the company in a better position for competition with those of other makers Many of the large industrial corporations of the country have intimate connection with groups of inventors especially skilled in certain directions

From the foregoing it is readily appreciated that the problems presented to many of our industrial organizations necessitate the employment by them of men of scientific and technical training, graduates of our colleges and technical schools, or those trained in the school of experience, who being presented with a problem and having knowledge and originality, can, if the occasion demands, create inventions It is not surprising, therefore, to find that to these men, the identity of whose inventions is often lost in that of the organizations of which they are a part, we owe many of the improvements which mark our industrial progress

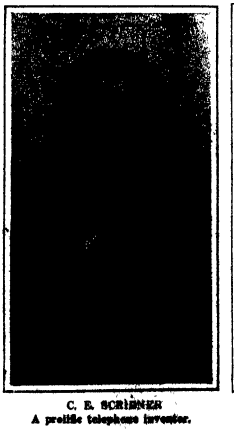
The employment of technically trained men by the large companies will be found extending throughout many arts, but it is natural that it should be found especially emphasized in the electrical and metallurgical developments to which much of what follows will be confined, serving to illustrate the importance, in fact the practical necessity, of the inventor as an adjunct to large industrial corporations While it is impossible within the limits of this article to enumerate all such that are worthy of mention, a few illustrative cases will serve to indicate how greatly we are indebted to these men for the advances made in the arts.

The metallurgical art furnishes many interesting examples of difficult problems met and solved by men of genius in the line of their employment. To illustrate, it would perhaps scarcely occur to one not confronted by the fact in actual working, that the variable quantity of moisture in the atmosphere might produce a deleterious effect in the operation of blast furnaces and steel converters which, as is well known, consume large quantities of air, the former in the process of reducing the oxides of iron, and the latter in the oxidation of certain impurities Nevertheless, it is a fact that the presence of moisture in appreciable quantity is injurious because it absorbs heat due to its decomposition at high temperatures, and moreover, the variations in the quantity of moisture produce corresponding irregularities in the quality of the product It is estimated that between sixty and two hundred and forty gallons of water per hour may be delivered to a blast furnace in this manner. The effect can readily be appreciated Since the air must be supplied under pressure and in enormous quantities, the use of chemical agents for removing the moisture does not offer a ready solution of the problem. The difficulty was effectually solved, however, by James Gayley, who devised a system wherein the air, under pressure, in its passage between the blast engine and furnace or converter, was cooled in successive stages by contact with a series of pipes arranged to conduct a refrigerating fluid across the direction of the air current. The air before being fed to the furnace or converter was, in this way, cooled to a temperature at or below zero degree Centigrade, which caused the precipitation of the greater portion of its moisture. The water of condensation was then drawn off through pipes provided for that purpose In this way, substantially dry air was provided, the amount of moisture being practically uniform from day to day.

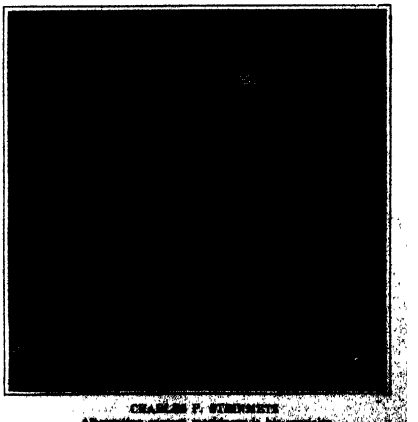
To William R. Jones we are indebted for a method of cheapening the cost of production of Bessemer steel. Prior to his invention the indirect or cupola process was generally used in this country. This process consisted in running molten metal from the blast furnace into pigs; these after cooling were carefully assorted, broken up and remelted in cupola furnaces from which the molten metal was conveyed to the converter for conversion into steel. Many attempts were made to eliminate the costly intermediate steps by supplying the converter direct from the blast furnace, but the fluctuations in the chemical composition of the metal from the blast furnace were such as to render the final product of the converter of uncertain character. The necessity for obtaining a uniform product will readily be appreciated when we consider the annual fatalities due to broken rails alone. The



ELIHU THOMSON
Notable for his work in electric welding.



C. E. SCRIBNER
A prolific telephone inventor.



CHARLES P. STEINMETZ
Alternating current machinery is his specialty.

[illegible] to [illegible] a stopper at [illegible] the [illegible] the [illegible] the idea of [illegible] [illegible] [illegible] between the blast [illegible] [illegible] [illegible] which should receive the [illegible] [illegible] from the blast furnaces and maintain [illegible] [illegible] in such quantity that its average composition would not be materially altered by the addition from time to time of much smaller quantities of variable composition. From this mass of substantially uniform composition the converters were supplied, and the resultant steel product derived was substantially uniform. This invention illustrates in a forceful way the familiar fact that often the simplest expedient reveals the highest degree of invention, and also shows what small differences often lie between success and failure, for the chief difference between Jones' device and prior known devices resided in the size of his reservoir whereby he was able to obtain metal of substantially constant composition.

Perhaps nowhere is the efficiency of organized effort better illustrated than in the advances made in the arts by the engineering departments of the electrical companies.

In the telephone art appear such names as Scribner, a prolific inventor who has done much to standardize telephone installations, and Dean and Dunbar, to whom is due much credit for the development of the so-called two-wire switchboard system whereby the third wire of previous systems is dispensed with. Worthy of special mention, also, is the invention by Scheisinger of the four-relay cord circuit, a form now widely used in many telephone systems, in which its use is held to be practically indispensable. Entitled to special note also is the invention by White of the so-called solid back transmitter, which has been a standard for many years.

Charles P. Steinmetz, head of the electrical engineering department of one of the large electrical companies, has done much constructive work in the electrical art, having made many important inventions in alternating current motors, generators, converters, regulators, lighting and the like, but perhaps his greatest contributions to the art are his remarkable mathematical treatises on the subject of alternating current phenomena, which are standard text books in electrical engineering, as well as books of reference for the practical engineer.

The mathematical accuracy of physical laws of action is well exemplified in the phase-transformer, independently invented by Steinmetz and Charles F. Scott, a prominent engineer of another company. This device, though structurally simple, would not have occurred save to one skilled in the mathematics of mechanics, while the value of the invention lies in the fact that it enables current to be transmitted of a number of phases capable of the most economic transmission, and then, by the use of the transformer, to be changed to a number of phases best adapted to local needs, as from a three-phase transmission line to a two-phase motor. The transformer consists merely of several primary and secondary coils so connected and inductively arranged that the electromotive forces in the primary circuit are resolved into components corresponding to the number of phases desired, thus inducing electromotive forces of the same number of phases in the secondary coils, which supply the secondary circuit.

Dr. Elihu Thomson, one of America's leading authorities on matters electrical, is regularly employed by a large electrical company. His work on high potential and high frequency apparatus and also on electric welding is notable.

Many important inventions have been made in electric meters by Schellenberger, Pratt, Tingley, Conrad, Davis, Bradshaw, and other engineers of the various companies, while the synchronizer of Lincoln, which enables the phase and frequency of an incoming generator to be determined preliminary to connecting it to line, is also a valuable addition to its art.

Of particular importance among regulators for electric systems is the invention by Tirrill of the regulator which bears his name. The characteristic which renders this regulator of particular value is the quickness with which it acts to control the generator voltage responsive to changes in the load on the line.

Much progress has been made by the engineering corps of the electrical companies in the electrification of railways and interurban lines. Prior to the present decade direct current only was available for railway purposes. This could not be economically employed on the longer lines owing to the difficulties of transmission at ordinary voltages and the heavy sparking at the brushes encountered when higher voltages were used. On the other hand, alternating current, which can be efficiently transmitted to relatively great distances at ordinary voltages, could not be employed because no thoroughly satisfactory variable speed alternating current railway motor had as yet been devised. Within the past decade, however, not only has the length of direct current systems been increased by the employment of interpole generators and motors of efficient design, which has rendered the use of much higher voltages possible, but also the problem of the alternating current variable speed railway motor has yielded to the ingenuity of engineers in charge of construction work of this character, and successful variable speed alternating current railway motors are now in operation on many of our roads, notably the New York, New Haven and Hartford. Prominent among the inventors of this country in the development or the alternating current railway motor are Lamme, Alexanderson and Milch, while abroad much valuable work of a pioneer character has been done by such prominent engineers as Winter, Eichberg, Latour, Derl, and others.

Few fields have claimed more attention recently than that of lighting, and many important improvements in this art have resulted from the extensive experiments conducted by the well-organized departments of the various electric companies. Just and Hanaman have done much to develop the tungsten light, and Kuzel also has rendered efficient service in this line, the latter having invented the colloidal process for the manufacture of tungsten filament. The importance of the tungsten light will be readily appreciated from the fact that for the same amount of current it furnishes substantially 100 per cent more light than the ordinary carbon lamp. Prominent in the development of the flaming arc are the names of Steinmetz, Dempster and Ladoff, while the names of Steinmetz, Thomas, Weintraub, and Kruh are conspicuous in the development of the mercury vapor lamp which, owing to the uniform distribution of its light and the absence of sharply defined shadows, renders it admirably adapted for use in machine shops, drafting rooms, and like places, in which it has found extensive use. The mercury vapor lamp, suitably modified, is also used as a rectifier of alternating currents, especially in the charging of storage batteries from an alternating current source of supply, since it occupies little space and is inexpensive and simple in operation.

Further enumeration might be continued almost indefinitely, but the few instances selected will indicate to how great an extent the development of the arts is due to the inventor whose invention is often not associated with his name.

The First Trans-continental Aeroplane Flight

Account of the Record-breaking Aerial Journey by Calbraith P. Rodgers on a Wright Biplane

BY his arrival at Pasadena, Cal., at 4.04 P. M. on the afternoon of November 5th, aviator Rodgers practically completed his great trans-continental flight, although the real finish did not occur until several days later, when he flew the 35 miles remaining, and landed on the shore of the Pacific Ocean. Rodgers' start was made from the Sheepshead Bay race track, near Coney Island, on September 17th last. He started with the intention of competing for the $50,000 prize offered by the proprietor of a New York newspaper. The time limit within which this prize could be won expired on October 10th, but Rodgers flew on just the same, despite many mishaps and breakdowns. His total time to Pasadena was 49 days. The distance covered was some 3,350 miles, and the time in the air 82 hours. This corresponds to an average speed of about 40 miles an hour.

Besides breaking all records aviator Rodgers carried with him letters from Postmaster-General Hitchcock. Several of these were delivered in Chicago and others, including one from Major-General Grant to the Department of the Pacific and another from the commanding officer of the Atlantic fleet to Rear Admiral Thomas of the Pacific squadron were carried the entire distance across the continent and delivered.

We have followed the progress made by Rodgers from week to week in the columns of the SCIENTIFIC AMERICAN, and now that he has completed his flight, it will be interesting to summarize briefly and give the causes of his various delays. The two chief causes appear to have arisen from bad weather and breakdowns of the motor. He was forced to descend some eight or ten times on account of engine failures. Some of these were simple troubles, such as a wire coming loose or the fouling of a spark plug, but toward the end of his flight, at Imperial Junction, Cal., a connecting rod broke loose and punched a hole in the motor case, and Rodgers was obliged to replace the motor with a spare one which his special train carried. While starting from Middletown N. Y. the second day, Rodgers struck a tree and smashed his machine. This delayed him three days before he could start again. At Shamokin, N. Y., his next stopping place, he descended on account of slight engine trouble and was delayed half a day because of a storm. After flying 50 miles farther to Canisteo, he again descended on account of engine trouble. He mistook a marsh for a solid field and damaged his machine in alighting. The next day, however, he flew 99 miles to Red House, where he alighted to change a spark plug. In restarting, he ran into a wire fence smashing his machine and propellers, which caused a two days' delay. Engine trouble is of course blamed for this, as if he had not alighted at Red House, he would not have collided with the fence there. At one other point in Texas, in starting on a narrow road, Rodgers smashed his machine by colliding with a fence. Two days were spent resting and overhauling the machine at San Antonio and El Paso, Tex., respectively.

All told, some 13¼ days were lost making repairs, and of these, 2½ days can be laid directly to engine trouble. The weather was responsible for the loss of 11 days, so that a total delay of 24½ days was occasioned from weather and repairs. Deducting this from the total time of 49 days, we have 14½ days as the actual time of making the flight, which shows the possibility of crossing the continent in a month's time by aeroplane, in case one does not meet with bad weather and serious mishaps. It should be remembered that Rodgers chose a roundabout way, going far south into Texas and then following the line of the Southern Pacific Railway. He broke the world's long-distance cross-country record on October 10th, when he reached Marshall, Mo., after a flight of 214 miles, as he beat by a few miles Atwood's record of 1,365 from St. Louis to New York, which flight was completed on August 25th.

One of the important events in the course of his flight was his meeting with Robert G. Fowler at Tucson, Ariz. Fowler, it will be remembered, previously tried to cross the Rockies in his Wright biplane, but failed. On October 20th he left Los Angeles, determined to make the flight across the continent by the southern route. Up to November 6th, he had covered 235 miles in 16 days' time.

A comparison of Rodgers' flight with the first trans-continental automobile trip is interesting. The first attempt was made by Alexander Winton and Charles Shanks in 1901, but the Winton car was stuck in the sands of the great American desert. Two years later, however, Dr. H. Nelson Jackson and S. W. Crocker accomplished the feat of crossing from San Francisco to New York in a Winton machine, having a double-opposed-cylinder engine, in 65 days. A single-cylinder Packard automobile, driven by Tom Fetch, accomplished the journey in 62 days, including a four day stop at Denver, and an Oldsmobile, driven by L. L. Whitman, made the journey in 72 days. All three trips were made in the summer of 1903. The following year, Whitman and Carris crossed the continent from the Pacific to the Atlantic, a distance of 4,500 miles, in 33 days, thereby beating by 28 days the best previous record, and in 1906 a 6-cylinder 30-horse-power Franklin air-cooled automobile was driven 4,000 miles across the continent in 15 days, 2 hours, and 12 minutes. This cutting down of the time to one-quarter in but three years shows the rapid development of the automobile from 1903 to 1906.

The aeroplane has developed so much more rapidly that two years ago the past summer, Oliesslagers remained aloft more than five hours and covered a distance of 240 miles, while of late distances of between 700 and 800 miles have been covered in a day with only a few stops. With a reliable motor, and the development of an automatic stability device which will enable the aviator to fly in windy weather it should be possible to cross the continent in ten days' time, and without doubt this will soon be done. What a great time saver the aeroplane is was demonstrated time and again, especially in the far west, where Rodgers frequently out-distanced his special train by from one to two hours. Flying over mountains and canyons he found rather risky, but at the end of his journey he announced that Beachy's flight above Niagara Falls and down the gorge last summer was, in his opinion, the greatest flight ever made. The Wright biplane had for the second time broken the cross-country touring record.

Big Fortunes in Little Inventions

Men Who Saw the Importance of the Apparently Unimportant

By William Atherton Du Puy

EVERY time anybody in the United States pulls the cap off a beer bottle or a soda water bottle with the intent to quench a thirst, temperately or otherwise, he puts the fraction of a cent into the pocket of one William H Painter, of Baltimore A good many people have pulled these caps in the last few years and Painter is consequently an ever increasing millionaire Yet the cap for bottles is a small thing, an idea crystallized and patented The patent is the source of the millions

Painter, however, carried his patent in his pocket for six years before he succeeded in interesting capital in its manufacture Then a man of means advanced the necessary capital in return for a half interest in the patent and a company was formed At the end of the first year he and Painter each had a net $27,000 in his pocket Now the invention has crowded all other stoppers for fizzy water off the market and a big factory in Baltimore turns out the caps by the million every day

Before the time of Painter there was a man by the name of De Quillfeldt who lived in New Jersey and who invented a stopper that took the trade away from the corks of our youth This stopper was of rubber and was tightened by a wire attachment which was pulled down as a lever on the outside of the bottle A decade ago they were generally used on milk bottles De Quillfeldt is said to have made $15,000,000 out of his patent He might have amassed a competence had it not been for William Painter and another equally clever person who fitted a piece of pasteboard into the neck of a milk bottle and took the business away from him

An idea that is perhaps simpler than the pasteboard stopper is the "bump" on the hooks that furnish so much employment for married men just before theater time Women had been fastening their dresses up with hooks and eyes for a generation and it is probable that some one had made a lot of money out of the original invention But hooks had a way of coming unfastened much to the chagrin of the neat and fussy Then came the genius of the hook and eye A man who was wide awake despite his residence in Philadelphia, bent one of these hooks so as to make a bump in it He tried hooking it, and found that it remained hooked He patented it and has monopolized the business through his "see that bump" advertisements ever since

One day a man stood behind his wife while she put up her hair The hairpins of those days were straight pieces of wire They did not "stay put" very effectually The woman in this case bent her hairpins before putting them in Her husband saw her do it The result was the invention of the crinkly hairpin which is to day used in carload lots by the women of the world

So important an invention as the telephone was made by turning a screw one fourth of one revolution All the millions that have resulted from the invention of the Bell telephone, depended upon this slight twist of the wrist of Dr Alexander Graham Bell There had been men before Dr Bell who had come near finding a way to make female gossip and masculine commercial intercourse easier The Reis patents came nearest success But in the Reis patents the current was intermittent It had to leap a gap Dr Bell closed that gap when he turned the screw But Dr Bell was not trying to invent a telephone when he incidentally stumbled upon his secret He was working on a method of making speech visible, for his wife was deaf and dumb and he was seeking an easy method of conversing with her Instead he found the method of talking over a wire to people at a distance He did not patent the idea however and it knocked about his house for months Finally he demonstrated it to some friends and they saw the possibility of its application Upon their advice he patented the invention His patent was filed at ten o'clock in the morning and at three in the afternoon another man applied for a patent on the same thing and lost a hundred million dollars by a nose

Such are the stories that the veterans of the Patent Office gossip about in the moments of their leisure They tell you, for instance of the Selden clutch which is one of the vital patents that has much to do with the control of the automobile business of the country It is this clutch that enables the operator of the machine to stop and start without having to get out and crank his machine—sometimes It is interposed between the running gear and the motor, where it keeps the car marking time while the crossing is blockaded.

This clutch was invented before automobiles were. For a decade after its invention there was no opportunity of applying it to any good purpose Then the automobile was invented In fact George B. Selden was one of the early builders of automobiles and it is logical to suppose that he built them that he might make an opportunity to use his clutch Certain it is that he long had a clutch on the automobile business Before his patent was declared invalid about $2,000,000 had been paid by nearly ninety automobile makers, who found it cheaper to pay than to engage in expensive litigation

Thaddeus Fairbanks was a New England farmer with long whiskers and much Yankee ingenuity In his time old-fashioned steelyards were the only accurate means of weighing the produce of the farm. Platform scales were unknown, for nobody had ever worked out a method of arranging the levers that supported the platform in such a way that an object would pull equally no matter upon what part of the platform it rested Old Thaddeus Fairbanks used to tell the story of the evolution of the arrangement of these levers For a long time the problem was upon his mind He used to lie awake nights and attempt to arrange those levers It was in the dead of night that his thinking finally bore fruit The arrangement unfolded itself and the Fairbanks scale was the result So did a farmer practically monopolize the scale business of the world and so did he write his name upon platform scales wherever civilized man buys and sells by weight

It was a man by the name of Hyman L. Lipman, likewise a resident of Philadelphia, who invented the rubber eraser that throughout our generation has been attached to the lead pencils in common use. It was in 1858 that the invention was made In those times people talked in much smaller figures than nowadays Lipman was, however, able to cash in his patents for a cold hundred thousand dollars when dollars went much farther than they do to-day.

So did a man by the name of Heaton, resident of Providence, notice that mother was occasioned a great deal of trouble because the buttons constantly came off the children's shoes. Heaton devised the little metal staple that holds on the shoe buttons of to-day and realized a fortune for his pains No less clever was a man of the name of Dennison who pasted little rings about the hole in a shipping tag and thus made an "eye" that would not pull out

Elias Howe conceived the idea of placing a hole near the point of a needle and under the encouragement of this small thought was the sewing machine developed Howe was one of the Columbuses in the development of a machine to sew seams and deserves a monument from the women he emancipated from needle work When he asked Congress to extend the term of his patent for a short time (one extension had already been granted he admitted that he had collected $1,185,000 in royalties, but considered himself entitled to $150,000,000.

Howe had many followers who improved the sewing machine One of the cleverest of these was the man who patented the stitch his machine made instead of the machine itself, and thus made infringements more difficult Another man, Allan B Wilson, a journeyman cabinet maker of Pittsfield, Mass, who dropped into the office of the SCIENTIFIC AMERICAN in 1849, exhibited the first model of what has since become known as the four-motion feed He afterward founded the firm of Wheeler & Wilson and became immensely wealthy In the SCIENTIFIC AMERICAN of 1849 James C A Gibbs saw a picture of Wilson's machine. The working of the device was clear down to the point where the needle perforated the cloth He wondered what happened after that. Finally he decided to make the needle work After much thinking and infinite whittling he worked out the ingenious little revolving hook which became the important feature of the Willcox & Gibbs machine and which made that firm wealthy

The man who was born too early to wear, as a boy, red top boots with a brass tip across the toe, was also born too early to feel the true thing in the way of pride run rampant. Silverthorn brass tips, they were called, and they were most serviceable in preventing holes in the toe Silverthorn made his fortune out of them.

There is a palatial mansion up the Hudson with a private yacht moored beneath the Palisades that is a monument to the millions that Adams made in the chewing-gum business. It was in 1871 that chewing gum was patented and millions of willing jaws have wagged industriously upon it ever since.

Harry Hardwick invented an ingrain carpet with the threads of it so interwoven as to prevent wrinkling, and Hardwick is now $4,000,000 better off for his pains.

A towel manufacturer found that his machinery was not working right and that his towels were suffering a vast tangling of the threads. While adjusting the machine he used one of the damaged towels to dry his hands. He found it pleasingly absorbent, and from the idea to which that gave rise was born the bath towel and a fortune to the patentee.

Charles Edward McCarthy was a blind man and lived in South Carolina. He devised a method of attaching mule power to a cotton gin and lived his life out in luxury and ease while the mules did the work.

The cast iron tombstone is a patented article that is to-day covering the graves of many of the dead and departed. It is effective and economical. It has amassed a fortune for its inventor and proven a solace to the mourning yet undecided survivors of the nation's dead.

R. R. Catlin of Washington invented a pattern cat that need but be stuffed with hay and sewed up to become a toy Such figures as "Billikens" and such games as "Pigs in Clover" are always a fortune to the inventor if they become popular. The rubber return ball made much money both for the inventor and likewise for an infringing manufacturer who fought him in the courts.

The brass paper fastener which is still generally used for thick documents, was patented in 1867 by a government clerk by the name of G. W. McGill. Yet it was not new, for the Romans used a similar device two thousand years ago and the modern appliance was but a resurrection.

The patent for a typewriter lay dormant for half a century in France before it ever came into use. Then a man by the name of Sholes made a machine in this country and called it Remington. Another man named Brown made a different kind of typewriter and called it the Smith The patentees immortalized other men by their work They made millions and also made it much more pleasant for the editor who has to read copy

The man who invented tin cans made it necessary for somebody to invent an opener This was done and the money corralled A can opener is not a very laborious thing in the using, but the public is always ready to pay for things that are made easier So, just recently, an inventive genius made a can with a seam just below the top and when the owner wants it open he has but to strike it a blow where the seam breaks and the top is off A single Chicago packer ordered ten millions of these cans as an experiment and others followed suit The inventor has a fortune, and the thing is but just begun

So does the story of the making of big fortunes out of patents on very small and apparently unimportant things pyramid as one goes into the subject. There is a current belief to the effect that but few of the many patents issued are of any practical value The writer had occasion recently to look through a series of the issues of the Patent Office *Gazette* and was struck with the number of patents and found that one in three was assigned, this meaning that a third of all patents issued were sold before completed. These patents must be of value or they would not sell. There are others, of course, that are of value that are retained by the patentee. So it would, on this basis, seem reasonable to estimate that half the patents being issued are of value. Many of them are of stupendous value. An estimate of the revenue being to-day received from patents of the United States would be impossible to make but it seems safe to say that many of the great staple crops will have to look to their honors if a census of patent profits is ever taken.

Silk Growing in the Philippines

THE Philippine Bureau of Science is making a determined effort to introduce the growing of silk in the Philippines, not only for the purpose of increasing the productive possibilities of the Islands generally, but also as a means of furnishing silk for use in connection with industries already established. Thus considerable silk is used in the weaving of various forms of the well-known "jusi," or pineapple-fiber cloth, for which the Philippines are famous, and ninety-five per cent of this silk is now imported from China.



The trailer now rotting away at Menlo Park.

Edison's Pioneer Electric Railway Work

By T. Commerford Martin



Ruins of one of the trucks.

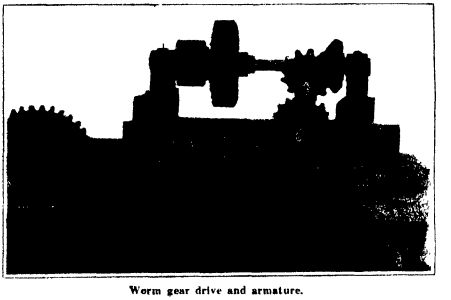
MENLO PARK, New Jersey, is associated in the popular mind, more perhaps with the incandescent lamp than any other invention, but there also Edison did his great and original work on the telephone, the phonograph, and the electric railway—not to mention a few other things of importance. There does, however, seem to be a general tendency to insist that a man shall have no right to more than one invention, as a basis for fame, just as monogamy is a basis for offspring. Morse for the telegraph, Brush for the arc lamp, Edison for the incandescent lamp, Bell for the telephone, Sprague for the electric railway, Stanley for the transformer, Tesla for modern power transmission, Thomson for electric welding, Marconi for the wireless, Weston for meters—that is about the way the territory of electrical invention is supposed to be roughly divided up. Yet most of these men have done more than one big thing; and in each of the domains there have been other notable figures.

Looking back these thirty years, one might perhaps wonder what Edison was doing with the electric railway in 1880, when he had already so many other inventive troubles on his hands; but no kind of preoccupation ever prevented Edison from taking up a novel idea that challenged his insatiable curiosity and his passion for experiment. Besides, the air was full of a trusting belief that to electricity all things were possible. The successful introduction in quick succession of the quadruplex, the telephone, the dynamo, and both forms of the electric light, was an immense stimulus to other endeavor, and the problem of perfecting and utilizing the electric motor haunted every aspiring imagination. Edison's ambition would have required a straight jacket to keep it away from such an opportunity.

In these days, when long stretches of main railroad are electrified and when every large steam terminal is under sentence of death, as obsolete, it is hard to believe that the beginnings were so crude as the pictures herewith show them to have been. But it had been very much that way for fifty years prior, back to the work of Davenport and Davidson; and one may feel amazed that although so much had been done it all amounted to so little. Evidently a new point of departure had been reached with new men, from whom both in Europe and America real progress must date.

Edison had plenty of spare land around him at Menlo Park, and the adjacent country was not preoccupied by intensive cultivation. Hence it was easy and inexpensive to lay out a single track about one-third of a mile in length which ran from the laboratory along a country road, flanked a hill and came back like a belt to its buckle. The rails were "second" street car rails, and anybody who remembers the street railway construction of the early eighties will not contradict the assertion that the "irons" could not have been much worse. The gage of the track was about three feet six inches, laid with ordinary sleepers on the natural grade. To these sleepers the rails, insulated with tar canvas paper and other stuff not much more effective, were spiked. There were various sharp curves of dangerous short radius, and the hill gave the chance for a nice grade of about 60 feet in 300. It was all delightfully amateurish, but enthusiasm and serious intent carried through.

The power plant consisted of two of the small light-



Worm gear drive and armature.

ing dynamos then being built at the laboratory, each of about 12-horse-power, and the electrical energy was conveyed from them to the track by underground conductors, for which Edison always had a keen predilection as against overhead wires. About 75 amperes at 110 volts was the yield of each machine, so that subject to track losses, not to exceed 25 horse-power, was available at the motor. As with his lighting Edison's traction system was operated in parallel.

The locomotive was worthy the rest of the equipment. It was a four-wheeled iron truck, an ordinary flat dump car, some six feet long and four feet wide. On this chassis, another of the "Z" dynamos of 12-horse-power was mounted as a motor, laid on its side. The armature end projected in front of the locomotive and the rotative movement was transmitted to the driving axle by means of friction pulleys. The wheels of the locomotive had metal rims and a central web of papier maché or wood. The current was taken up from the track on one side by contact brushes, from the wheels, through a brass hub to the motor, and the return circuit was completed through the other set of wheels, i. e., the motor was in parallel. It had its field magnet circuit in permanent connection as a shunt across the rails, with a safety fuse in the shape of a bit of bare copper wire, while a switch in the armature circuit gave the motorman ability to reverse the current flow in the armature and thus reverse the direction of the locomotive.

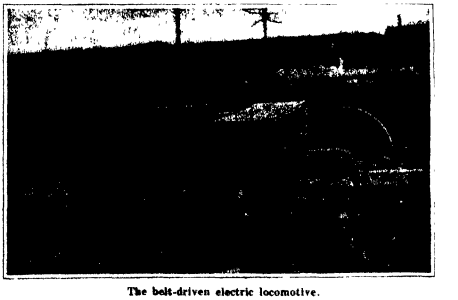
As one might expect now, though it was not so obvious then, this friction gear was not able to stand up under the strain put upon it, especially when all the "boys" in the shops piled on like rush hour passengers in the subway. May 13th was the day in 1880 when the road was thus tried out, and it was a memorable date at the "Lab," as well as in the history of electric traction, for Edison was thus applying many of the principles of the multiple arc distribution now universal, as well as the low internal resistance dynamo with its high resistance field.

For mechanical transmission, Edison next resorted to belts, and the armature pulley was belted to a countershaft on the locomotive frame, while the countershaft was belted to a pulley on the car axle, and there was an idler pulley for tightening the axle belt, worked by the lever which had previously thrown the friction gear into adjustment. As the motor was started the armature came up to full revolution, the belt was tightened on the car axle and the locomotive moved off. But there was a lot of slip, the rubbing of the belts caused serious charring, and it on the other hand the belt was suddenly tautened up, the armature was burned. The odor of burnt armature was grimly familiar during the tests. The next step in the evolution was to employ a series of resistance boxes in the armature circuit. The locomotive would be started with all of these "cut in," and then it was brought up to full speed by cutting them out successively. After loading up the locomotive with a generous superabundance of these boxes, Edison came to the conclusion that he was carrying a lot of unnecessary dead weight. He, therefore, dispensed with most of them very ingeniously by winding copper resistance wire around one of the long legs of the motor field magnet. There it occupied no space, was inconspicuous, served as an additional field coil in starting up the motor, and proved an important advance. This coil was also in

(Continued on page 456.)



The electric train of Menlo Park.



The belt-driven electric locomotive.

EDISON'S PIONEER ELECTRIC RAILWAY WORK

Perpetual Motion

Some Examples of Misguided Ingenuity

OUT of nothing, nothing comes. This is really a wonderful axiom. Men will grant it at once as an abstract proposition. But when they apply it to real things, some seem to get confused, and entertain expectations which if realized would set this axiom at naught. The same general truth is expressed by the statement, *Every effect must have a cause.* This, too, will be granted by pretty much everybody, until application to real things is made.

Perhaps no one has trouble with a case where there is absolutely nothing at all. From a space where there is no matter, whether solid, liquid or gaseous, no one will expect anything. But juggle matters a little. Put in *A*, put in *B*. Suppose it to be known just what *A* will accomplish and what *B*. And suppose, further, that we have found, subsequent to our combination of *A* and *B*, that we can trace these accomplishments of *A* and *B*. Call them *a* and *b*. Now right here is where some seem to go astray. They seem willing to believe that in addition a new thing, *c*, might *somehow* turn up. Well, if it should, then we will have a case of something coming from nothing. We might, just as well, expect that sometimes 2 and 2 would produce 5. The additional unit here would be no more wonderful than *c*.

This is the trouble with the seekers after perpetual motion. They really expect something from nothing, they expect an effect without a cause to produce it. They take a machine (*A*) and a certain amount of energy (*B*) and expect that somehow the combination will give rise not merely to the machine itself (*a*) and a total of energy (*b*) equivalent in amount to what they put in (*B*). They expect not merely *a* and *b*; they look for an additional energy *c*. If they get it, they will get something out of nothing; they will get an effect without a cause behind it. It is just as ridiculous as expecting to get 17 separate ounces of metal by cutting up a pound of steel. Just as soon as one thoroughly grasps the idea that energy is a real thing, he is prepared to understand that it cannot be increased by manipulating it. He is then ready to see that, if he puts 2 foot-pounds into a machine, he cannot expect to get 2½ foot-pounds out. Indeed, he may apparently get *less* than 2, because some of the energy will be transformed into heat and will be radiated off and thus may escape observation.

However, men have been working at the impossible problem of getting something out of nothing for hundreds of years. And, some are probably still at it. No doubt, there are to-day men in the United States who think that a machine can *somehow* be made, which will run without energy being constantly put into it. It is just as if they expected to cut the 8-inch square into two separate parts, and get a 5 x 13 inch rectangle by putting these parts together in a different way.

That the possibility of a perpetual motion machine has not been entirely given up will be understood when it is learned that 575 application for patents for such apparatus were made to the British Patent Office in the period 1855 to 1903. This is about ten patents a year.

In Fig. 1 we have an example cited by Mr. F. F. Charlesworth of the British Patent Office. An endless band or chain is arranged to mesh with two sprocket wheels. The band carries a series of cups, or rather dippers so attached that the handles are continually perpendicular to the band. Heavy balls are fed one by one to the open dippers on the descending side. When the dipper nears the bottom, a projecting horn intercepts the ball and guides it away. It will be seen that this machine will run as long as the balls are fed in at the top. In the form shown, an elevating screw is used to bring the balls to the top and permit their use over again. This endless screw is driven by mechanism connected with the shaft of the upper sprocket wheel. The thing lost sight of here is the fact that it will require as much energy to lift the ball to its initial position as it will develop by falling. It was proposed, apparently for this same machine, to provide for the return lift of the balls by conducting them along an incline to a hollow tower filled with quicksilver or some other liquid. Once a ball had entered the base of the tower, it would rise to the surface of the quicksilver because of the difference in specific gravity. It could then be recovered by a lifting device, dropped onto an incline and fed into the machine again at the top. A very fine scheme—the only difficulty lay in getting the balls into the bottom of the quicksilver column.

Consider now Fig. 2. We have here a similar arrangement to that shown in Fig. 1. However, the endless band is here of rubber and hollow. Instead of dippers, there are hollow rubber projections or arms. On the following side of each of the arms, conceiving the whole to turn with the hands of a watch are air-sacks. To these weights are attached. When an arm is rising and the weight is consequently underneath, there will be a distension of the sack. This entire apparatus is immersed in water. It is expected that it will now begin to move clockwise. The rising side is lighter than the descending one because the distention of the air-sacks has decreased the specific gravity on the one side. All air compartments communicate with the main tube. There is no change in the tension of the air. As a weight at the top passes into the position where its sack collapses, another sack will be distended at the bottom, and so the air required will have the same volume. At any rate, this is the general scheme. But why won't it work? The reason lies in the progressively increasing pressure of water as one passes downward beneath the surface. It is this that should raise the distended side. But it is also this that resists the movement of air from the top to distend an air-sack at the bottom. The distension of the air-sack at the bottom is broadly the same problem as introducing a metal ball into the bottom of the column of quicksilver.

Refer now to Fig. 3. This represents what appears to have been a French "solution." An air-tight bellows *DFE* is arranged on an axis perpendicular to the paper. The total length of the bellows is about 40 inches. There is an aperture at *E'*, by means of which and a suitable tube there is a communication between the interior of the bellows and a vessel of mercury *G*. This vessel is fixed in position at about the level of the shaft on which the bellows turns. *B* is a counterpoise, while *C* is a clasp which serves to retain the bellows in position with a moderate amount of strength. Suppose now the bellows to be forced open, say, to a third of its capacity. Quicksilver will flow from *G* and after a time, so it is claimed, the weight within the bellows will exert a turning effort sufficient to cause it to break away from the clasp. The lower end of the tube *E* will continue in the mercury bath. Then the entire movement will be arrested at the position shown in Fig. 4, and another clasp *H* will engage the bellows. The mercury rose before, because of the height of the tube *E* being less than that of the usual barometric column. The mercury now will run out from the bellows and the latter will collapse. The counterpoise *B* then operates to bring the bellows back to its initial position. Arrived here, whatever mercury remains within, falls to about 27 inches height, whereupon mercury from the reservoir will rise to flow into the bellows, because the length of the tube *E* is considerably less than 27 inches. This is essentially Dr. Papin's account of this scheme. What is wrong with the device?

Consider now Fig. 5. Here we have a drum filled with water or other liquid and arranged on trunnions. Upon one of the trunnions, a fly wheel is mounted and a suitable belt carries the power from the generator of perpetual motion. By means of stuffing boxes two rods pass through the drum. These rods are mutually perpendicular. Weights are arranged on the ends of these. It will be understood that if we could always have the same amount of weight on the two sides of a drum or wheel, but the weight on one side so managed as to be further from the axis of rotation, the wheel or drum would turn. The excess of leverage on one side would cause that side continually to descend. To manage this shifting of the weights, the inventor provided the rods with cork spheres centrally arranged. Evidently when the one rod is vertical, its cork float will, if suitably dimensioned with respect to the two weights, cause the upper weight to rise and so project from the drum at a maximum distance. There will be no tendency for this position to be lost until after this vertical rod has taken up a horizontal position. The condition shown in the figures is where one rod is vertical and the other horizontal. The vertical rod and its weights will, apart from previous movement, exert no turning effort. But the horizontal one will, since one of its weights is farther from the axis than the other. Motion will be set up in the direction of the arrow. Of course the rods must be so arranged as to prevent interference between their cork floats.

A simple device is shown in Fig. 6. An endless chain passes around two wheels *BB*. A trio of idle wheels *CCD* deflects the chain from the vertical on one side. The result here is that a greater length and consequently a greater weight of chain are continually on the right-hand side. Presumably, we have a clockwise movement here. The difficulty is that the deflected portion, although heavier, does not exert the full effect of its weight. The gravitative pull of this portion operates downwardly in an exactly vertical direction. But since this gravitative motion is nonuseful, as we say, on the topmost wheel, at an angle, there is some loss. To make this perfectly clear, suppose a chain to hang precisely vertical. At the point of tangency the gravitative pull will be in the direction of the tangent and therefore most effective. Deflect the chain in or out, and the gravitative pull will be at an angle to the tangent and so at some loss. In point of fact the axles of the wheels *BCB* sustain a certain fraction of the weight of the chain.

Consider Fig. 7. Three rotatable shafts are arranged horizontally so that a vertical section would show the shaft sections at the vertices of a right-angled triangle, as disclosed in the figure. Suppose now that an endless chain be arranged to envelop these rollers. It might be thought that, since the hypothenuse is longer than the vertical side, a uniform chain would set up a clockwise movement. The explanation just given, however, prepares us to understand that this will not be the case. In fact the disadvantage under which the gravitative pull of the hypothenuse is delivered is just compensated by its excess of weight. Such an arrangement will be a well-balanced, immovable one. But suppose that the metal chain be replaced by a band to which sponges are attached, the whole being enveloped by a string of evenly distributed weights. Suppose, in addition, that the horizontal portion of the apparatus be immersed in water. We now have a device conceived by Sir William Congreve, probably about 1827. Sir William was a member of the British Parliament and the inventor of the celebrated Congreve rockets. This machine was expected to turn counter-clockwise. The *modus operandi* was conceived to be as follows: On the vertical side a sponge as it entered the water would be uncompressed by the string of weights and therefore free to absorb water by capillary attraction. As a sponge emerged from the water at the lower end of the hypothenuse, the line of weights would operate to compress it and thus keep it comparatively dry. Because of the difference in weight on the dry and wet sides, the whole system would move.

Perhaps the most celebrated efforts in the direction of perpetual motion have been made in connection with the continued distribution and redistribution of weights within or about a wheel movably mounted upon an axle or trunnions. The purpose is to have the same number of weights upon the downgoing and upgoing sides, but to have the average distance from the axis of rotation greater upon the downgoing side. It is conceived that, on the principle of a difference in leverage exerted by the two groups of weights, we should get a never-ceasing motion, if this relation could be perpetually maintained. One of the most distinguished of those who gave attention to this matter was the second Marquis of Worcester who flourished about the middle of the seventeenth century. This gentleman wrote in his "Century of Inventions" of a device whose purpose was "to provide and make that all ye weights of ye da/cending syde of a wheele shal be perpetually further from ye center, then tho/e of ye mounting syde, and yett equall in number and heft on ye one syde as ye other. A moſt incredible thing if not scene, butt tryed before ye late King of happy and glorious memorye in ye Towre by my directions, two Extraordinary Emba/adors accompanying his Maſte and ye D. of Richmond, D. Hamilton, and moſt part of ye Court attending him."

He goes on to relate that the wheel, or drum, was 14 feet in diameter and was provided with 40 weights of 50 pounds each. When this wheel was put in motion, it was claimed, so it seems, that as the weights successively passed the vertical diameter above they hung a foot further from the center, and that as they passed this diameter on the lower side they would hang a foot nearer. It would seem that the precise method by which this result was accomplished is not certainly known. However, it is thought to be substantially as indicated in Fig. 8. It will be seen that the distribution to right and left is about equal, so that so far as more weight is concerned, we have a balance. But there is a preponderance of leverage on one side. The view represents the position at a certain definite instant. And we may grant that this instant displays conditions in a fairly typical manner. It would seem then that the Marquis was perhaps gratified when he said, "See pleated to judge ye consequence."

Half a century or thereabouts later, a celebrated apparatus was constructed more than once by Jean

(Continued on page 460)

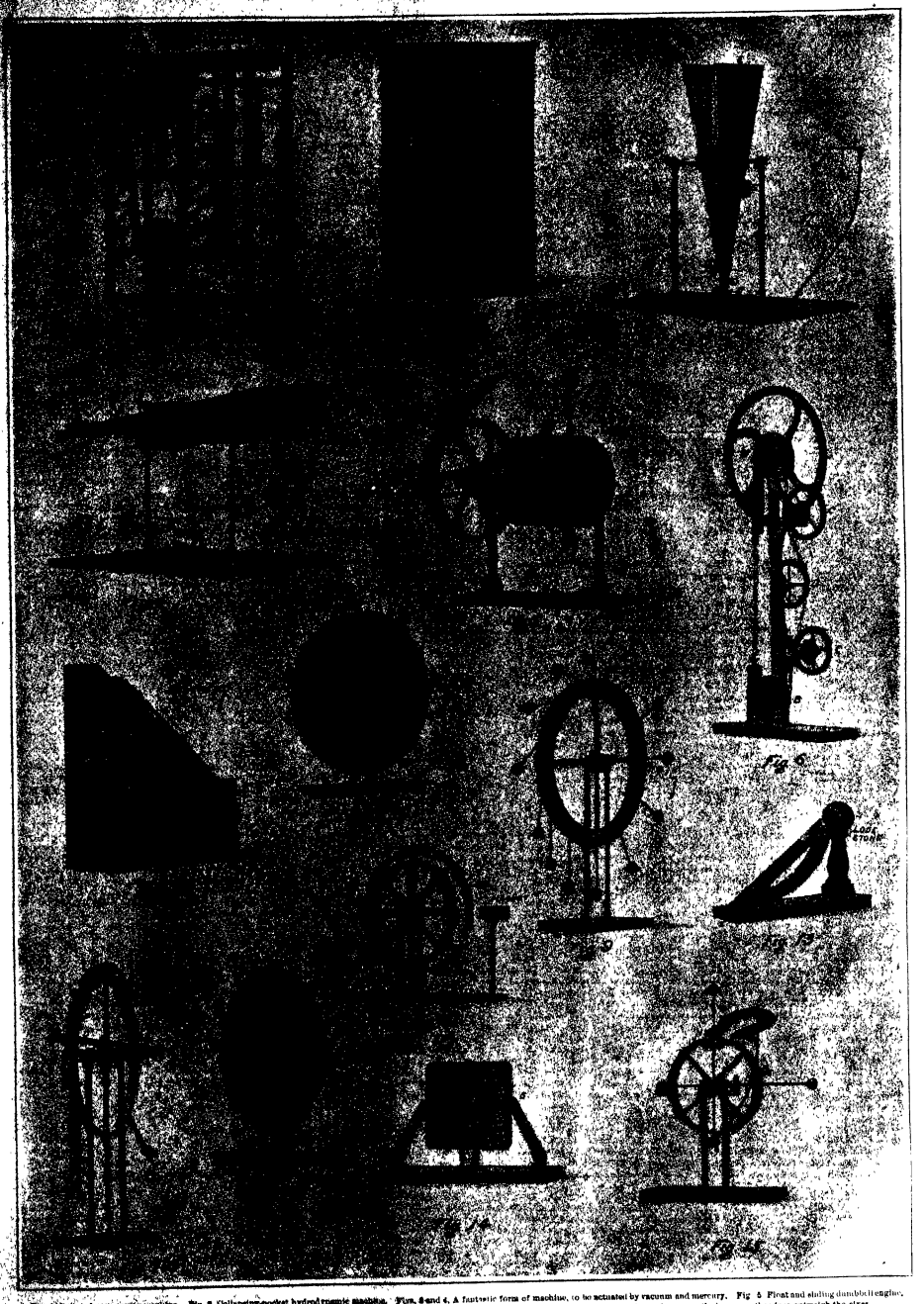
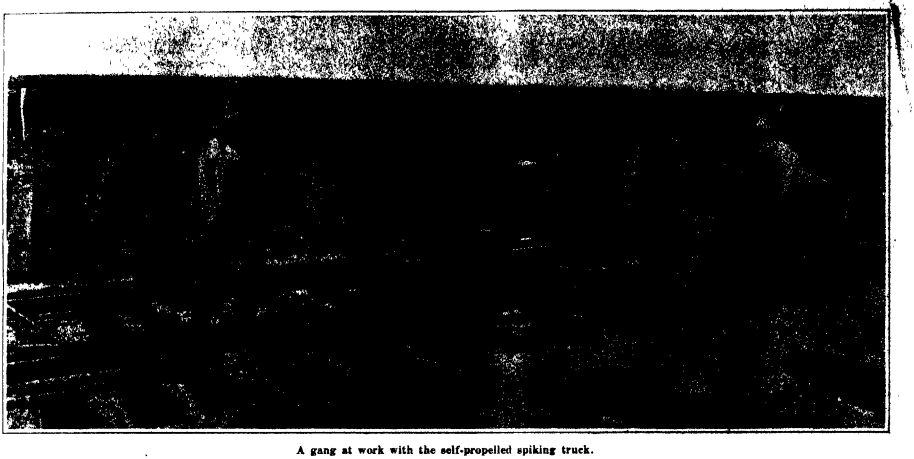


Fig. 1. Rod and cup gravity machine. Fig. 2. Cog gravity machine. Fig. 3. Collapsing-pocket hydrodynamic machine. Figs. 4 and 4. A fantastic form of machine, to be actuated by vacuum and mercury. Fig. 5. Float and sliding dumbbell engine. Fig. 7. Capillarity engine. Figs. 8, 9, 10. Three forms of gravity perpetual motion wheels. Fig. 11. A suggestion quite as practical as any; the nines outweigh the sixes Figs. 12, 13, 24, 25. Magnetic perpetual motion machines.

SOME EXAMPLES OF MISGUIDED INGENUITY



A gang at work with the self-propelled spiking truck.

Spike Driving by Motor Truck

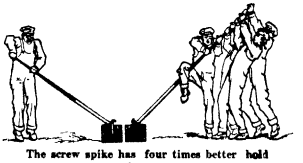
Protecting the Public from Railway Accidents

THE number of ties required annually for renewals and new track by the railroads of the United States is estimated at 154,000,000, which, at an average cost of 50 cents apiece, represents the enormous sum of $77,000,000. Less than half of these, an ever lessening supply, are hardwood. Soft wood ties become unfit for service from decay, chiefly of the fibers under the rail, where the wood is cut and injured by the rough nail spikes with the continual up and down play of the rail and spike. When we remember that any loosening of the spikes, with consequent spreading of the rails, is liable to lead to most serious accidents and loss of life, the importance of the problem of thoroughly securing the rails to the ties becomes obvious.

Screw spikes have been introduced with much advantage in place of nail spikes. In the first place, the screw, in entering the wood, does not injure it to the same extent as the nail spike; secondly, an item of no small importance, a screw spike has about four times the holding power of a nail spike, as indicated diagrammatically in one of our illustrations. This greatly lessens rail movement with the resultant loosening of the spike and laying open of a cavity in the wood into which rain and moisture penetrate.

One of the principal obstacles which have hitherto stood in the way of general adoption of screw spikes in this country has been the expense of putting them in by hand labor and with primitive tools. But this obstacle is one which can be and has been removed. Our half-tone illustration and one of the line drawings illustrate a self-propelled gasoline motor car which is in service boring ties and inserting screw spikes by mechanical power. This not only reduces the cost of spiking to a minimum, but also greatly expedites the operation of track laying and re-spiking.

The motor car is provided with cranes at the drilling end which hold the drills when not in operation. At the spike driving end similar cranes are provided, which hold up the spike drivers at all times. These cranes not only take up the whole of the weight of the instrument but also the torsional thrust, so that the operator is merely required to exert a downward pressure on the tool, to keep the spike driver from slipping off the head of the spike, and to move the driver from one spike to another. The spherical bulb near the bottom of the instrument, seen on the right-hand side of the line drawing, is a friction clutch adjusted to slip when the spike has been screwed in to the desired degree of firmness. Without this friction clutch the engine would be stalled or the head of the spike twisted off. The spike driver is connected to the motor by a telescoping shaft of such length that three ties can be reached without moving the car. The work of boring the holes is effected ten times more rapidly with this equipment than by hand, and requires less skill, and

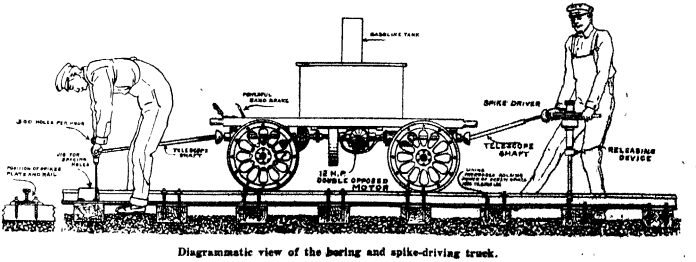


The screw spike has four times better hold than the nail spike.

of course much less effort. The cost of labor also is greatly reduced. The car is kept on the track throughout and is advanced just as fast as the spikes are screwed into place. When not in use the drill and extension shaft are hung in the hook of the crane. The modern standard track laid with this gasoline motor car consists of 110 pound rails, carried on tie plates and fastened by means of screw spikes to treated ties. The gasoline engine is sufficiently powerful to haul when necessary two or three cars loaded with section men and their supplies, such as jacks, claw bars, lining bars, shovels, ties and rails. A specially designed friction clutch in the connection between the engine and the propelling gear of the car makes it possible to start a heavy load from a standstill without stalling the engine. The clutch may, of course, be thrown out entirely when the car is standing still and the engine is being used for spike driving. There is no doubt that the car will find many other applications beside that for which it is specifically designed. If run in conjunction with a small auxiliary air compressor or electric generator, it will be handy for operating rivetting hammers or similar tools at a distance. It might be used for spraying paint or mixing concrete. By adding a suitable blade attachment the car may be turned into a mowing machine for cutting grass and weeds from the right of way, or it may be used to operate mechanical tamping bars which are being developed in connection with this outfit.

One of the valuable features of the car is its great simplicity. A lever in the hands of the operator controls the motion forward or backward. The throttle and spark control levers are on the seat just behind the operator's right knee, while a lever under his foot operates the brake. At the back of the seat is a gasoline supply tank which holds a sufficient quantity of the oil for ten hours' continuous operation.

The motor is arranged crosswise, a position which is said to provide a maximum cooling effect during motion. The car has started without difficulty on a heavy grade and a 23 degree curve with all the men on board who could get a foothold.



Diagrammatic view of the boring and spike-driving truck.

SPIKE DRIVING BY MOTOR TRUCK

The Kubus of Sumatra

PROF. W. VOLZ, of Breslau University, has published in *Petermanns Mitteilungen* a paper on the Kubus, who live in the interior forests of Sumatra, and, owing to their complete isolation by several natural barriers, appear to be a typical example of an absolutely primitive race. The life of the Kubus is comparable to that of the anthropoid apes (gibbons), which inhabit the same forests; they appear to be at the lowest stage of economic development—the gathering stage—having not yet become hunters. Prof. Volz believes that they totally lack religious conceptions.

Welding a Fourteen-inch Shaft by the Thermite Process

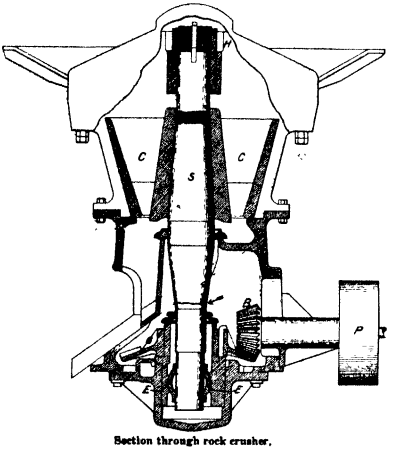
A Fine Example of the Adaptability of Dr. Goldschmidt's Method

THE Goldschmidt thermite process has now become so firmly established in various industries, that we accept it more or less as a matter of course, and have almost ceased to be stirred by the spectacular liberation of energy which accompanies its application to various purposes of ordinary industrial use. When, however, such a gigantic operation as the welding of a fourteen-inch shaft is in progress, even the most cold-blooded witness must wonder at the fierce intensity of the reaction and at the perfect control under which it is kept. Most violent reactions are explosive in character, owing to the disengagement of large volumes of heated gas. The thermite reaction has the great advantage that all substances taking part therein, both the initial material and the products, are solid.

A rock crusher belonging to the North River Stone Company, Kingston, N. Y., was recently disabled by the fracture of the central shaft. The construction and mode of working of this crusher can be gathered from the accompanying illustration. A vertical shaft *S* is suspended from a head *H*, and extends axially through the crusher-chamber *C*, the walls of which are faced with a lining *L*. A similar lining *L'* is placed around the working face of the conical portion of the shaft. The latter, at its lower extremity, is held in an eccentric bearing *E*, which is rotated in the casing of the crusher by the gear *G* through the beveled pinion *B* and pulley *P*. The motion of the shaft is that of a conical pendulum, that is to say, its upper extremity is fixed, while the lower end travels around in a circle. There is no rotation about the axis of the shaft. The rock is fed into the crusher-chamber, and is there ground between the lining of the hopper-walls and the sleeve of the shaft, as the latter revolves in its eccentric orbit, thus periodically approaching toward and receding from a given point of the chamber wall. The ground rock issues at the side by a chute. The break occurred near the point where the lower cylindrical portion of the shaft joins the tapering conical part. (The location of the fracture is indicated in the drawing by an arrow.) The shaft here measures 14 inches in diameter, while at its thickest part it is 22 inches across. The total length is 18 feet, and the weight about seven tons.

The accident to the shaft meant a period of idleness of at the very least six or eight weeks if a new shaft were ordered. The owners of the plant therefore turned their thoughts to the possibilities of repairing the damage by the aid of the Goldschmidt process. This plan was ultimately realized with a saving of several weeks' time and at about one-third the cost of a new shaft. The broken member was shipped to the works of the Goldschmidt Thermite Company, at Jersey City. The fractured surface was pared off with the oxygen blast, taking away in all about 2¼ inches. The two portions of the shaft were then mounted upon a solid concrete bed, so as to secure perfect alinement, with the space of about two and one-half inches left open between the two ends that were to be welded.

The first step toward effecting the weld is to prepare the mold. For this purpose a wax pattern of the finished joint is first formed about the ends to be joined, and the mold, of equal proportions of fire clay, ground fire brick, and fire sand, is then built up around the shaft, leaving of course channels for pouring in the charge, a riser to allow for the contraction of the cooling metal, and a blast hole, for the introduction of a gasoline compressed-air torch, to preheat



Section through rock crusher.
The shaft broke at the point marked by an arrow

the mold and casting before welding. During the actual operation this blast hole is plugged. The mold is enclosed in sheet iron walls, and this completes the welding furnace.

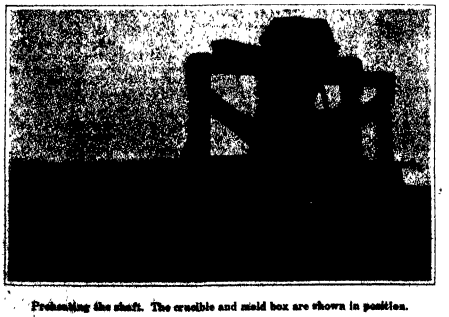
During the preheating, which occupied in this case about ten hours, the wax pattern of course melts away, leaving a free space for the metal of the welded joint. About the furnace is built a wooden scaffolding of trestles, which supports the hoppers containing the charge of thermite, as seen in one of our illustrations. It may seem odd that wood should be used for this structure, since it has to withstand not only the heat of the furnace during the preheating operation, but also the assault of the spattering charge and slag during the reaction. As a matter of fact wood serves its purpose quite satisfactorily, for though it has to be continually watched and kept moistened, and is pretty sure to catch fire during the reaction, it holds up very well even under these strenuous conditions, while an iron structure would be cut right through by any of the molten charge falling upon it. The charge consisted of 1,100 pounds of thermite, mixed with 25 per cent of small steel punchings, 1 per cent of chromium thermite, and 1 per cent pure carbon free manganese. This charge of thermite, exclusive of steel punchings, is about enough to make 600 pounds of steel. The reaction temperature is about 5,400 deg. F.

After adding a teaspoonful of ignition powder (barium peroxide and aluminium flake) to each hopper, the reaction is started by introducing a red hot iron bolt. A flash, a glare, a hiss and sputter, and clouds of smoke envelop all, as the elements wrestle in fierce combat for union with the coveted oxygen, the greater affinity of the aluminium quickly asserts itself, and after a forty seconds' round the iron is vanquished, thrown out of combination and enslaved in the service of man. About one minute is allowed to lapse in order to allow the slag to separate, then the tap-holes of the hoppers are pushed open, and the white-hot molten charge runs into the mold, filling the space prepared for it, and effecting the union of the adjoining ends of the broken shaft. The main part of the work is now done. It only remains to allow the iron to cool—a matter of some forty hours—and the mold can be broken away, exposing the welded joint to view. The excrescences left by the pouring holes and the riser are cut off with the oxygen blast, and the job is completed—for in this particular case there is no need of machining the welded joint.

The repair of the crusher shaft was thus effected with complete success, giving one more striking example of the wonderful possibilities of the Goldschmidt thermite process.

Horse-power and Man-power

IN connection with steamship propulsion the average man is apt to speak very glibly of so many hundred, or thousand, horse-power. But, says the *Railway and Locomotive Engineering*, it is extremely doubtful if one person in a hundred really has a due appreciation of what the phrase actually means. On this point some very interesting remarks were made at the last annual dinner of the Scottish staff of *Lloyd's Register* by Mr. John Heck, the Glasgow engineer surveyor to the society. Proposing the toast of "shipbuilding and engineering," he said that, calculating the strength of twelve men to be equal to one horse power, it would require 840,000 men to produce as much energy as the 70,000 horse-power developed by the turbine machinery of the express Cunarder "Lusitania." Then, if the men were to work on the eight-hour day system those figures would give a total of 2,520,000, that being the number of men whose strength would be necessary to drive the vessel across the Atlantic Ocean. So it would take all the men in Scotland to supply the energy produced all the day round by the wonderful turbine machinery of this great ship.



Preheating the shaft. The crucible and mold box are shown in position.



Finished weld showing metal left in gate and riser.

WELDING A FOURTEEN-INCH SHAFT BY THE THERMITE PROCESS.

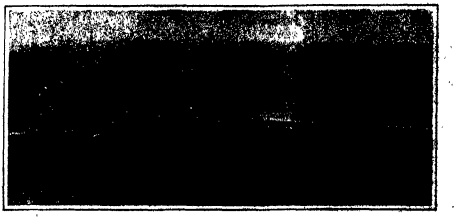
Curiosities of Science and Invention

A Vessel Broken in Two

THE accompanying photograph shows the wreck of the steamship "Santa Rosa" belonging to the Pacific Coast Steamship Company, of San Francisco. For some years past, the "Santa Rosa" has been plying between San Francisco and San Diego, on the coast of Southern California. While on a voyage to the latter port, the vessel veered from her usual course, during heavy weather, and very early on the morning of July 7th, she piled up on the rocks of Point Arguello, near Santa Barbara. At the time, the steamship carried about 200 passengers, and a heavy and valuable cargo.

Four vessels very soon came to the rescue of the "Santa Rosa," and strenuous efforts were made to pull her off of the reef. Hawsers were hitched to the stern of the steamer, and the four vessels began tugging away. A heavy sea was running and the rocks on which the vessel was lodged, were very ragged and sharp. Between the rocks and the angry sea, the "Santa Rosa" broke about amidship but still hung together. However, the enormous strain of the four tugging vessels, was so great, that the steamship was literally pulled in twain—just as she appears in the photograph—making a very odd-looking wreck—one of the most peculiar ever seen on the Pacific Coast.

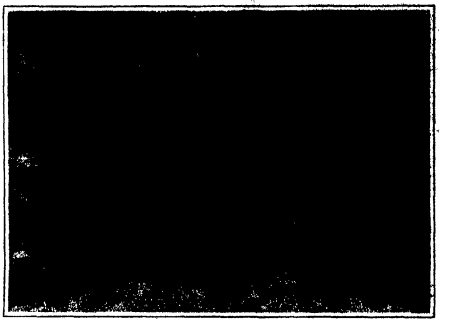
Both stranded steamer and the cargo proved a total loss.



Broken in two on the edge of a reef.

Devastation upon the Railroad Caused by the Breaking of the Austin Dam

THE accompanying photograph gives an excellent idea of the tremendous power in a stream of water that is suddenly released, as was the case when the dam broke at Austin, Pa. recently. In the path of the onrushing water were located the yards and railway shops. One would scarcely believe that so substantial and heavy a piece of machinery as a freight locomotive could be completely demolished by the water, yet the photograph shows two of these engines almost as badly damaged as they would have been in a collision or by the bursting of their boilers. In the foreground appears the truck of a freight car. The car itself was undoubtedly carried far down stream with the onrushing current. The tracks of the railroad were twisted and bent, in one instance even into a complete circle.



Locomotives wrecked as the result of the breaking of the Austin dam.

An Automobile Scissors Grinder

AN ingenious French mechanic is shown at work in the accompanying illustration, sharpening a pair of shears. With a small gasoline motor three wheels, a pair of springs, etc., he has built himself a novel tricar with which he can quickly go from place to place and drum up trade. A similar vehicle can be seen about the streets of New York, but the American scissors grinder has only progressed to the point of using a gasoline motor to run his grindstone, both the latter and the motor being mounted in a horse-drawn wagon. The Frenchman has the advantage of not having a horse to feed, and as long as he is a mechanic, he has no difficulty in keeping his novel tricar in repair.



A self-propelled scissors grinder.

Veterinary Use of X-Ray Photography

FOR several years Roentgen-rays have been used successfully by the medical profession as a means of determining the nature of a broken bone, thus facilitating the setting of it, and the location of foreign bodies such as bullets in the human body. But, never before to our immediate knowledge has this branch of science been used to aid the veterinarian in the examination of a horse.



Taking an X-ray photograph of a horse's injured leg.

The owner of a stock farm, near Lexington, Kentucky, has a very valuable young horse which was injured about three inches above the pastern on the left hind leg. The surgeon in charge thought that probably a nail or other foreign body was broken off in the injured part. The horse was brought to Prof. M. L. Pence, of the State University of Kansas. Wires from the coil were passed out of the window of the Physics Building and connected to the Roentgen-ray tube which was held in a clamp stand.

The horse's right hind leg was held up as if being shod, while the tube was placed about sixteen inches from the part to be photographed. The sensitized plate was held as near the leg as possible on the opposite side from the tube and the exposure made. Two such exposures of different lengths were made, the one of ten seconds giving excellent results. A Roentgen-ray picture of the hand may be made with this coil by an exposure of two or three seconds. With a coil requiring several minutes to make an exposure, it would in all probability be difficult to get a horse to refrain from moving long enough to obtain the exposure.

The interrupterless coil used is an extraordinarily fine one of German make, this being the first university in the United States to have one of this type. It is admirably suited for many other experiments in the physical laboratory.

The Exploration of the Brahmaputra

IN his presidential address before the Royal Geographical Society last May, Major Leonard Darwin named three fields in which the explorer may yet hope to win renown by robbing the unknown of its romance—the South Pole, the interior of Arabia, and the bend of the Brahmaputra.

The reasons why the siege of the South Pole has been so painfully protracted are sufficiently obvious; a glance at the map of Arabia shows a blank space of formidable dimensions, which, even if the country were less inhospitable and its inhabitants less hostile, might keep explorers busy for many a year; but the unknown stretch of the Brahmaputra, just north of the British frontier in Tibet, is so insignificant in extent that only the largest-scale maps of the present day distinguish it with dotted lines. The length of this portion, to which no European and no native surveyor under the Indian government has yet been able to gain access, is actually much less than one hundred miles.

Much of the surrounding country has been explored, and the general trend of the land is so well known that the identity of the Brahmaputra of Assam with the Tsangpo of Tibet is absolutely unquestionable. Yet even the attempts to obtain direct evidence of their identity by floating marked logs from the upper river, have hitherto proved unsuccessful.

There are two reasons why the many efforts heretofore made to unlock the mystery of the river have failed; first the extraordinary roughness of the country, and second the savage hostility of the Abors, the tribe through whose country the river runs. It is known that there is an enormous difference of level between the two known portions of the river. In a stretch of 130 miles the fall amounts to 10,000 feet; hence the descriptions emanating from Tibetan sources of stupendous gorges, falls, and rapids are quite credible.

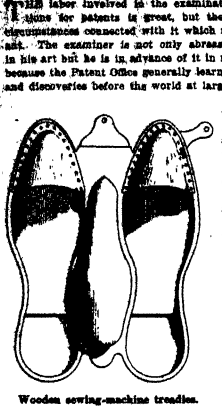
The savage character of the Abiyes was manifested a few months ago, when the latest attempt to ascend the river reached in the massacre of Mr. Noel Williamson, assistant political officer at Sadiya, his companion, Dr. Gregorson, and a party of 200 men.

The Funny Side of Invention

"Patentable Utility" as Illustrated in Some Issued Patents

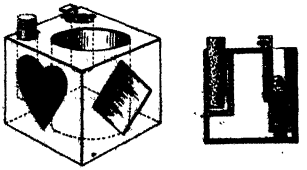
By Laurence J. Gallagher

THE labor involved in the examination of applications for patents is great, but there are certain circumstances connected with it which render it pleasant. The examiner is not only abreast of the times in his art but he is in advance of it in many instances because the Patent Office generally learns of inventions and discoveries before the world at large. Apart from the consideration of theories which are advanced in support of new inventions, the examiner also has to meet and successfully refute those theories which have no foundation or which are clearly due to the efforts of the applicant to obtain a patent. The patent law requires that an invention have utility and it is in setting forth the utility and in explaining it that many applicants go astray. This is especially true of the applicant who is prosecuting his own case and who, very generally, is ignorant of the technical requirements. Some applicants in the electrical art can see benefits in the use of their device which never occurred to others; they are enthusiastic over their discoveries and their elemental knowledge is supplemented in certain cases by imagination. Many of these applicants believe that the examiner cannot understand their inventions when the utility is questioned by him and the applicant is called upon for further information



Wooden sewing-machine treadles.

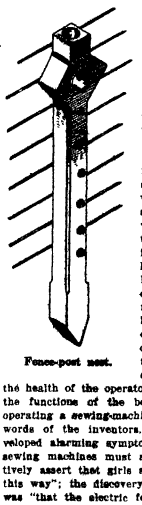
One inventor proposed to make a magnetic belt of a number of batteries adapted to encircle the body, the belt also containing a number of permanent magnets placed adjacent to the end cells of the batteries so that "each cell would be a pole"; it was also proposed to provide a vacuum in the belt, "this vacuum or hiatus to be filled with acid." The purpose of the belt was to furnish magnetic currents to the body, "all the electric currents of the batteries being converted into magnetism." The number of cells in each battery could be varied at will since "the greater the number of batteries used the greater would be the magnetism until sufficient batteries were added to produce magnetic stress." The terminals of each battery were to be in contact with the skin, the magnetic currents flowing through the body, the operation being described as follows: "When the belt is applied to the body, magnetism is produced by detached currents of electricity which are alternated and induced through the body according to the laws of inductive diffusion and reflex action. This passing of current through the body in this manner produces a sedative and tonic



The indispensable tally block.

effect; the more the batteries are used the greater will be the magnetic potency and polarity." The particular function of the "vacuum or hiatus filled with acid" was "to break up the currents that would tend to run around the belt, thereby assisting in forming alternating currents, the alternating currents being held in suspension by magnetic force, the crossing of the alternating currents producing minor magnetic centers in the body, the induced currents produced by the magnets damping the alternating currents in producing magneto-electric currents."

The name magnetic belt was objected to by the examiner who suggested that electric belt would be a proper term; the inventor replied to this as follows: "If my magnetic belt makes more magnetism than electricity, then it is a magnetic belt and is rightly named; if four or more of my batteries in my belt do not make an excess of magnetism then it makes nothing; electricity makes magnetism and cannot live without it. Magnetism is a mode of permanent electric force, and it differs from the other modes of electric force in that the energy it excites in a body is always present, especially at the extremities, the extremities of a magnet are called poles, and the properties they exhibit are termed polarity, polarity increases magnetic force; the more poles the more magnetism. When four electric currents are properly arranged in my belt the ceaseless flow of interchangeable inductive alternating currents become supreme in magnetic force and potency. One battery alone in my case makes a direct electric current; but four or a dozen batteries, four or a dozen currents, four or a dozen magnetic fields, detached, having broken currents, and when within an electrical radius of one another, producing induction and an amalgamation of mixed currents which are magnetic by an overcharge of magnetic poles, electric currents, and magnetic fields. An electric current is a stimulant and an exciter and dangerous in cases of fever and heart disease; a magnetic current is sedative and safe in the above cases; this I have experienced in treating patients and this is another reason why my belt is not an electric belt; but a magnetic belt is the same as an electro-magnetic belt, and is better understood; magnetism and electricity go together in some proportion anyway, and magneto-electric would suit no better than my original name of "Magnetic Belt." The inventor probably became muddled as he proceeded in his argument which accounts for the statement that, "magnetism and electricity go together in some proportion anyway."



Fence-post rest.

Another invention had for its object the diminishing of sickness and death among women and girls who operate sewing machines. The inventors in this case had spent twenty-five years investigating the physical and mental laws of health-culture and life forces, the causes of diseased humanity, and the remedies, and for ten years had been observing the many evils resulting from operating on sewing machines. During that space of time they did not find one case where the health of the operator remained good, and where the functions of the body were undisturbed after operating a sewing-machine for a short time, in the words of the inventors, "six months generally developed alarming symptoms." While admitting that sewing machines must and will be used, "we positively assert that girls and woman are sacrificed in this way"; the discovery which led to the invention was "that the electric forces of the system, in connection with the iron treadle and steel plate, are the ever-growing source of trouble in operating sewing machines." From many experiments the inventors explained the source of trouble as follows: "It is the electric current created by the friction, and the feet of the operator in contact with the iron treadle, and the hands with the steel plate. The treadle of the old spinning-wheel was wood; consequently there was no waste, and no cold feet. The wooden sandal naturally becomes warm from the system, and it being porous, and an element conducive to nature, it will assist the forces of the body and the friction produced does no harm. We have operated sufficiently to report from experience, and we know it is not the physical force needed to run the machine which leads to the alarming symptoms; neither is it the motion, as the motion under proper conditions would be beneficial. We consider rubber just as objectionable as iron and have seen many cases of disease from rubber coming in contact with the physical system."

The invention consisted in making the sandals which were connected to the treadle of the machine of wood, the feet being positioned in the sandals by means of leather straps, together with a wooden plate on the top of the machine and adjacent the needle and on which the operator's hands would rest while running the machine. This case is a good example of an exception to the rule that mere change of material does not amount to invention, since the humanitarian object of the invention and the untold benefits which would follow its use carried dignity.

Another inventor devised an attachment for telephones and submitted a description which was not clear to the examiner, upon being asked for further description the inventor replied as follows: "This instrument will work the minute central inserts the plug and therefore it enables a person to come to the 'phone before the same rings."



Mirrors in fork and knife handles.

Persons with excessive abdominal weight may reduce the same if they will make use of a device which exhibits much ingenuity in its manner of use, the corpulent one has himself strapped to a frame which extends down his back, there being a handle attached to the frame. He then lies down with his face to the floor and the frame and himself are rocked back and forth, the protruding mass of adipose forming an excellent fulcrum. The production and use of such an invention is a boon to humanity; the person of excessive weight may bring himself to size adapted to fit into the ordinary chair while those about him can use the space to which they feel entitled.

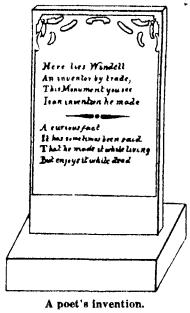
The prevention of collisions between railroad trains has offered and still offers a fruitful field for inventions. Whenever a person of prominence or authority travels over a railroad it is the general practice to have a pilot train precede the one in which he is riding; of course this is a departure from the general run of things and how to accomplish the same degree of safety with less trouble has prompted many ingenious minds. One patentee discloses a novel method, the invention involving the use of a pilot having telescoping members connecting it with the front of the locomotive. In the event of a train coming in the opposite direction on the same track the pilot will collide with the other train or with a similar pilot connected thereto, the result being that the telescoping connecting members slide into each other such movement resulting in closing the throttles and setting the brakes. The utility of the pilot is increased by providing a bell thereon together with an automaton for striking it, while the pilot is mechanical in its operation it is fitted with electrical devices which are actuated thereby which justifies the title "electric pilot."



Picture frame for tombstones.

A good part of invention is directed to small articles which may serve a variety of uses; these articles of manufacture are gotten up to sell at a small price and it is difficult to classify them. In most instances nothing just like them has ever been produced and the applications for patent are based in many cases on the purposes which the inventors intend to be served by the devices. A man devised a tally block and submitted an application for a patent, the block was in the form of a hollow cube, one side being provided with an opening for holding a piece of chalk or a pencil in order to keep count in a game of cards; the suits of a deck of cards were indicated on four of the sides, the block being turned into position to indicate the trump; one side was provided with a pocket which could perform

a variety of functions; another side was fitted with a movable index and a series of numbers in order to facilitate keeping the score While the block was intended primarily for use in a game of cards the inventor set forth in his specification a multitude of uses as follows "Besides the above mentioned convenience to a card player who uses my tally block for which I pray to obtain a patent, I claim it to become a constant companion to present humanity and countless millions to come The man of business will carry it in his coat pocket and rejoice to be in position to meet any emergency, a hole in his pocket does not bother him as he can carry his loose change in the tally block, the sponge in the pocket can be changed at will and can contain the perfume which will permeate his clothes Walking about the street his nose is apt to offer a good landing place for particles of soot, the little mirror of the tally block will keep him from looking at it x-eyed and spitting on his handkerchief, the sponge will perform that duty No fear of footpads, as a corner of the tally-block on the top of his head, with a gentle pressure, will make quite an impression Coming home baby cutting teeth and cross, will change into a smiling miracle when papa pulls out the tally block and juggles with it, its attention being riveted the pain is gone Coming home late from lodge meeting, and the key being about one inch out of his reach on the transom, the tally block is as good as a step ladder In case wifey thinks she heard a noise in the cellar or wants him to look at the gas meter the tally block answers the purpose of a candle holder It is a handy receptacle for studs, buttons, pins and chewing gum To a poet with inspiration or those who want to keep record of a dream and write in the dark, nothing takes the place of the tally block In shaving the mirror can be placed at proper height, the window in a street car can be raised a little to let in fresh air by using the block as a rest Instead of applying the tongue to moisten the backside of a postage stamp, the sponge will do it without the fingers coming in contact with it No crowding in a street car, as a block in your side coat pocket makes it uncomfortable for your neighbor to sit on it The fisherman no longer bends himself into an undignified position to quench his thirst, and the coast driver has something to block a wheel Anybody can elevate himself by standing on the block to get a peep at a passing procession It can be used as a pen wiper, as a paper weight, as a receptacle for pens, a book can be placed therewith in the proper angle for reading when so desired and pages turned by dampening the fingers with the sponge



A poet's invention.

"It can be put to use to measure with by having a measure marked on the side of the block or by knowing the size of the block and turning it a required number of times The house-wife will use it, saturating the sponge with turpentine and pack it away with the clothes to keep the moths out of them, or will use it as a block to darn stockings on The orator will place it before himself on which to mark his subject matter and turn the block as he progresses in his speech The lawyer uses it in his speech to the jury to illustrate on what side of the house the murder was committed The reporter uses it when he is short of paper, and the undertaker when he finds that the head of the corpse has not the proper elevation As a novelty, my tally block contains a dictionary full of them The foregoing uses of my invention, I mainly draw attention to in order to show its varied practical utility."

Some inventors can see the "beautiful" in their devices along with certain other advantages as the following will show: a man invented a concrete fence-post especially adapted for use on farms, the object of his invention and the accomplishment thereof being set forth as follows. "The object of the invention is to provide a fence-post which in addition to its usual function of protecting the farmer's fields against trespassing animals, also protects said fields by encouraging the little birds to come to the fields and destroy various forms of insect life that are injurious to the husbandman's trees, fruits and crops I accomplish the foregoing object and the further object of gaining for the toilers on treeless fields the inspiring, uplifting and encouraging companionship of the singing 'angels of the air,' by providing a fence-post which serves as a harbor, refuge, home and drinking fountain for a family of birds The fence-posts studding the boundaries of a field in large numbers will, accordingly, furnish a large number of homes for the birds and in a large measure take the place of boundary trees used as fence-posts as harboring places for birds." The fence-post was provided with a drinking cup which would receive some water during rainstorms, the post was also provided with a large opening which was lined with a water-proof material to serve as a nest

There is not much relation ordinarily between a table knife and a mirror, yet a mirror may be appreciated under some circumstances as the following will show "This invention relates to certain new and useful improvements in mirrors for table implements, and the object of the invention is to provide a table implement with a mirror suitably secured in the handle, so that the user of the implement may have ready at hand a mirror for the purpose of inspecting the teeth in the mouth or the mouth or other portions of the face generally at any time desired The invention is particularly designed for use in connection with table implements such as are used in restaurants, cafes, or other public eating establishments Oftentimes a patron of a restaurant finds the need of a mirror to discover a substance which has become lodged in the teeth, or for the purpose of determining whether the lips be entirely clean after eating certain foods It is not only inconvenient, but embarrassing oftentimes as well, for such patron to ask for a mirror to be used at the table In my device, however, the mirror being in the implement used by the patron during eating, may be used by him or her for the purpose indicated substantially without attracting any attention and is always ready for such use at any time desired"

An inventor is always obliged to submit a sheet of drawings illustrating his invention. If the invention permits illustration, some arts, especially that relating to tomb-stones, offers an opportunity to the inventor to set forth his thoughts One inventor, who was something of a poet as well, set forth the following inscription.

"Here lies Windell,
An inventor by trade,
This monument you see
Is an invention he made.
A curious fact,
It has sometimes been said,
That he made it while living,
But enjoys it while dead"

Another inventor devised a picture frame to be placed on a monument which was to contain a photograph of the deceased; the frame had a movable cover on which was the following "Look at me then cover my face"

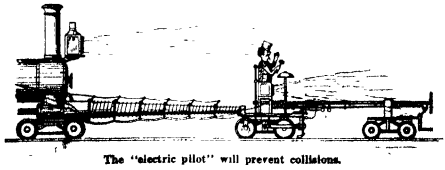
Another very practical device was a chewing gum locket, the inventor's object in setting forth his construction to the world was, "to provide a locket of novel form and construction for holding with safety, cleanliness, and convenience for use, chewing-gum, and which may be carried in the pocket or otherwise attached to the person, the improvement consisting in the provision of an anti-corrosive lining" in the locket Such an invention was undoubtedly of great value to chorus girls since it offered a ready means of cutting down one item of expense.

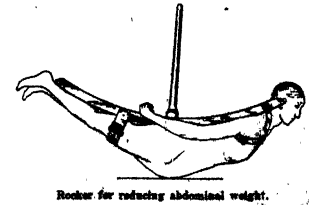
When an examiner picks up a new case for examination he never can tell what the examination is going to bring forth; each case involves the application of an idea which the applicant believes to be new; the idea may be impractical or may have the highest degree of utility and it is this determination, which in some cases amounts to uncertainty, that lends attractiveness to the work. Claims in an invention may be rejected by an Examiner upon proper references, which may be found in patents or publications of any sort. The citation of some references is very often objected to by an applicant who holds that the reference does not disclose the invention he claims. An applicant for a patent on a concrete chimney replied as follows to a rejection, the applicant probably being correct without really knowing it: "Solomon said, there is nothing new under the sun; consequently it is only a combination of old things that gets patented." In another case the inventor delivered himself of the following: "No one can tell what is the nature of the bars shown in the patent, and anticipation is not to be deduced from such nebulous disclosures; the prophet Nahum (Nahum 2 4) said, 'The chariots shall race in the streets, they shall jostle one another in the broad ways; they shall seem like torches, they shall run like the lightnings,' and some Patent Office *attachés* might be found to contend that the modern motor car was anticipated thus, and, while this Examiner would doubtless appreciate the error of their ways, it is almost as far fetched an anticipation as the one ironically cited above." Some applicants amend their cases hurriedly and follow out the suggestions of the examiner without consideration of the point raised; in one case an examiner believed that a specification could be improved and he wrote the applicant as follows. "Page 2 of the Specification, line 3, 'slotted' should be deleted," the applicant replied, "Page 2, line 3, cancel 'slotted' and insert 'deleted' in lieu thereof."


Chewing gum locket.

A Hot Summer in Europe

LAST July was the beginning of a period of excessive heat over western Europe The Weekly Weather Reports of the British Meteorological Office, after the first week of the month, noted "unusual" or "very unusual" warmth in nearly all sections of the British Isles The latter notation predominated, and this means that the excess of temperature was such as does not occur more often, in the long run, than once in twelve years More significant than the readings of the thermometer was the unprecedented fact that members of Parliament discarded their coats and transacted weighty business of state in their shirt-sleeves In London, the month was the warmest July for at least forty years past. In France, a remarkable period of unbroken sunshine prevailed, accompanied by excessive heat It is stated that not a single cloud was seen at Paris from July 2nd to July 24th A maximum temperature of 102 2 (Fahrenheit) was recorded at Rouen on the 22nd The hot weather continued, with but slight interruptions, up to the middle of September On August 9th a maximum temperature of 100 deg. F. was recorded at Greenwich Observatory—the highest ever observed at that institution. The heat was accompanied by drought, a water famine being experienced in many parts of England, where from July 1st to September 12th the rainfall (as measured at Greenwich) was but 30 per cent of the normal. The *Lancet*, discussing this unusual weather, finds that it was a serious factor in the recent strikes, so irritating was it to the temper of the people From the Alps come reports of dangerous avalanches caused by the melting snow and ice It is said that ice centuries old and probably never before seen by man was exposed to view under the burning sun. Small glaciers disappeared and large ones shrunk. Although complete discussions based on accurate observations are not yet available, it appears certain that the summer of 1911 will go down in history as one of the most remarkable in the records of meteorology.


The "electric pilot" will prevent collisions.


Rocker for reducing abdominal weight.

We advise you to accept the first delivery of a Cadillac which your dealer can give you

Please credit your Cadillac dealer with sincerity when he warns you not to lose your "place in line."

Many Cadillac dealers have reported sales of the entire number of cars which have been allotted to them for the 1912 season. Others have only a limited number yet to sell.

Your dealer may be confronting a similar situation.

At any rate, nothing he can tell you concerning the conditions in your own city can begin to do justice to the profound impression created throughout the world by the new Cadillac.

Prior to this year, the public has rightly looked upon the principle of automatic starting and lighting as speculative and theoretical.

But this same public remembered, when it learned of the perfection of the Cadillac system, that the Cadillac Company had never promised what it could not perform.

Indifference immediately gave way to eagerness, interest and enthusiasm.

The mere advance rumor that the Cadillac Company was about to announce its achievement made such an appeal to the public that the paramount problem confronting other cars is that which has ceased to be a problem in the Cadillac.

No one, now, is wasting any time or thought in debating the question as to whether the Cadillac electrical system is the correct and dependable system of starting and lighting.

Three thousand of the new cars, revealing the luxury of the Delco system, are stimulating the normal Cadillac demand to such an extraordinary extent that we advise you, again, to accept the first delivery your dealer can give you.

You who have not grasped their full significance—stop and consider these new comforts created by the Cadillac Electrical System



TOURING CAR, $1800

It has no crank.
Its "cranking" is done by an electric motor.

It has no gas nor oil lamps.
It makes its own electric light.

It has two complete systems of ignition, either of which is efficient for operating the car independently of the other.

But, best of all,—the three functions, starting, lighting and igniting, are all performed by one compact system, a system which is not obtainable, either in whole or in part, on any other car.

The dynamo charges a storage battery.

The dynamo is temporarily transformed into a motor and, acting as a motor, it automatically starts the engine.

Then—it reverts again to a dynamo and generates current for lighting and for ignition.

You—press a button and push forward the clutch pedal. The engine starts.

Nothing for you to think of—except the luxury of no cranking. Reliable as the motors which drive the trolley cars.

Nothing for you to think of—except the luxury of no lamps to light; and the brilliant, steady glow of electric lights instead. Reliable as the electric lights which illuminate your home.



TORPEDO, $1900



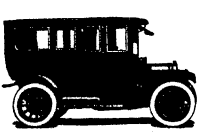
PHAETON, $1800



ROADSTER, $1800



[illegible], Four Passenger, $2250



LIMOUSINE, Seven Passenger, $3250

CADILLAC MOTOR CAR CO. - - - - DETROIT, MICH.



Special Fabrics for Sportsmen's Apparel

Forestry Cloth (Shade No. 65) is a unique fabric, made by us exclusively, for men's and women's wear, for such special uses as camping, fishing, golfing, mountain climbing clothing It is made of *highest grade, strictly pure, all wool worsted* — which experienced sportsmen know is the only material entirely satisfactory for outdoor garments.

Forestry Cloth (Shade No 65) is a beautiful Olive Green; a more perfect shade for the purpose could not be found

Forestry Cloth (Shade No 65) withstands the roughest use, holding its shape and appearance under all conditions. It is dust and wind proof, and sheds water Adopted by the United States Government as standard for the Forestry Department.

Olivette Cloth (a fabric similar to the above in weave) is made in an attractive shade of light brown, and is especially suited for riding and driving clothes, motorists' apparel, outing suits and raincoats.

Samples of *Forestry Cloth* and *Olivette Cloth* sent upon request. And if you are unable to procure these fabrics from your tailor, we will see that you are supplied upon receipt of price. When ordering specify fabric and number of yards desired. *Forestry Cloth* $2 75, *Olivette Cloth* $3.50 per yard.

American Woolen Company's Blankets

For Camp Bungalow and General Outing purposes, meet every requirement for warmth, comfort and wear Priced from $3 50 to $10.00 according to weight, design and quality If your dealer does not carry them write us and we will tell you who does or see that you are supplied

Oswego Serge is a staple year-round fabric for men's wear, a Serge-at-its-best which — owing to its dependability — has been produced year after year in increasing quantity by the

American Woolen Company

Wm.M Wood President

Oswego Serge grows in popular favor possessing those characteristics which appeal to well dressed men, and stamp serge as the fabric of universal wear

You seek style fit and finish Let us speak for **Oswego Serge** — a master piece of the loom, possessing wear feel, hang and finish. Made of finest wool, and — quality considered — priced low

In order to be sure of the cloth when ordering a custom suit from your tailor or a ready to wear suit from your clothier insist on **Oswego Serge**

If unable to obtain **Oswego Serge**, send us the name of your tailor or clothier accompanied by money order or check for quantity desired at $3.00 per yard and we will see that you are supplied

Samples furnished on request

AMERICAN WOOLEN COMPANY OF NEW YORK

J Clifford Woodhull, Selling Agent

AMERICAN WOOLEN BUILDING

18th to 19th St. on 4th Ave New York

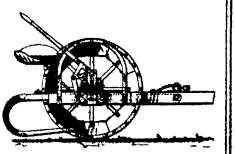


RECENTLY PATENTED INVENTIONS.

These columns are open to all patentees. The notices are inserted by special arrangement with the inventors. Terms on application to the Advertising Department of the SCIENTIFIC AMERICAN

Of Interest to Farmers.

POTATO DIGGER.—CLAYTON W FORD, care of William St. Dairy, Findlay Ohio. This invention is an improvement in potato diggers and is illustrated with a section view of the apparatus in operation the digger is drawn through the field, with a blade or plow a sufficient depth to pass below the potatoes, and



POTATO DIGGER.

as it moves along the potatoes are lifted from the ground During transportation, the plow may be lift d out of the ground, and by means of the lever it may be held at any desired depth The arrangement of the beam of the plow moving between the frame sections prevents any lateral swinging movement of the said beam with respect to the frame, so that the plow is held directly in the rear The width of the felly of the wheel is greater than that of the rings

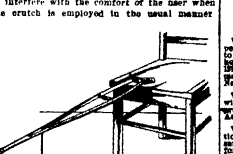
ALARM ACTUATING MECHANISM FOR INCUBATORS W M BRALL, Blackwell, Okla. This mechanism is certain in operation and will not be damaged by the increase or decrease of temperature beyond the points where it has been adjusted to operate The contact lever is pivoted to a rod mounted to travel in guides a spring being provided to hold the rod in a predetermined position the contact rod being connected with a thermostat by which it is operated. As the lever is operated by the thermostat it contacts with electrodes, to complete an electric circuit in which there is an electro magnet.

GIN SAW CLEANER.—H J FITZPATRICK, 158 Nellie B Avenue Athens Ga The invention refers to cotton gins and its object is to provide a new and improved cleaner arranged to permit the operator to throw the cleaner into action while the gin is running with a view to insure complete and quick removal of any lint or extraneous matter that may adhere to the saws

Of General Interest.

EXERCISING DEVICE.—E D ANGELL, 3000 Minn Avenue Corvallis Ore This exercising device comprises an elongated bag of canvas or leather or other suitable material filled with sand or other suitable substance to give it weight without rendering the same inflexible While it may be preferred to make the device flexible the body portion may be made inflexible as for instance out of wood or metal with the straps

CRUTCH SUPPORTING ATTACHMENT.—LOUIS REMICK 261 Madison Street Passaic N J This invention provides a crutch with an attachment which may serve as a support for the crutch when extended in a horizontal position and provides an attachment in a manner to avoid the same becoming an obstruction to interfere with the comfort of the user when the crutch is employed in the usual manner



CRUTCH SUPPORTING ATTACHMENT

The invention consists in adding a swinging strut or arm to the crutch which, when extended perp ndicularly from the crutch, is located into position to form a rest for the crutch when the same is extended in a horizontal position Means are provided for adjusting the length of the strut to equalize or to compensate for a seat or other place of rest of the user A perspective view of the invention is shown in the engraving

GARBAGE INCINERATOR.—J B HARRIS, 210 Stahlman Bldg Nashville, Tenn. The invention provides a sanitaire and odorless incinerator, more especially for use of municipalities, large manufacturing companies, etc., to permit convenient charging of the furnace with garbage or other refuse and continuous

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PATENTS

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Designs
Copyrights &c.

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A **Free Opinion** as to the probable patentability of an invention will be readily given to any inventor furnishing us with a model or sketch and a brief description of the device in question. All communications are strictly confidential. Our **Hand-Book on Patents** will be sent free on request.

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A BERLIN PATENT ATTORNEY wishes to enter into business relations with a reputable and thoroughly reliable young representative resident in Washington, with a view to establishing a branch office in Berlin, with reference, to be addressed to Berlin Patent Attorney " care of this paper.

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THE DEAF HEAR INSTANTLY with the Acousticon. For personal use, also for churches and theatres. Special Instruments. Call or write for booklet and free advice. Sociable free. General Acoustic Co., 26 Beaufort St. Jamaica, N Y. Only Perfect Sound. 8 Rue d'Hauteville.

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LOCAL REPRESENTATIVE WANTED.—Splendid income assured right man to act as our representative after learning our business thoroughly by mail. Former experience unnecessary. All we require is honesty, ability, ambition and willingness to learn a lucrative business. No soliciting or traveling. This is an exceptional opportunity for a man in your section to step into a permanent business without capital and become independent for life. Write at once for full particulars. Address E. R. Marden, Proprietary Realty Co.—Operators Real Estate Company, 1736 Marden Building, Washington D. C.

OLD COINS

OLD COINS.—$7 15 paid for rare date 1856 quarters, $50 for a 1804 Keep all money dated before 1895, and send 4c at once for New Illustrated Coin Value Book 4 x 7 It may mean your fortune. Clark & Co., Coin Dealers, Box 48, La Roy N Y

PATENTS FOR SALE

ATTENTION.—Railroad locomotive spark arresters, patented and for sale Railroad free attendance and prohibitory smoke stacks Also boiler compounds and steam engine cylinder lubricators in connection. Albert Lawrence, Soldiers Home, Hampton Va.

PANAMA CANAL, Rubber Stamps Novel and unique made of metal. Garrido or royalty Patented Mfd. For further particulars address, Henry Stevens, 119 Sixth Street, Milwaukee, Wis.

WANTED

WANTED.—Ship draftsmen, pay from $5.64 to $6.60 per diem, and assistant ship draftsmen, pay from $4.32 to $5.40 per diem. A competitive examination will be held at the Navy Yard Philadelphia, Pa. September 11, 1911, for establishing an eligible register of ship draftsmen For further information address "Commandant, Navy Yard, Philadelphia Pa."

WANTED mechanical articles—Wish to correspond with men who can write articles on aviation, saloon, bills wrestle and other machines; also on popular style. Address, Mechanics, Box 773, New York.

WANTED.—A man or woman to act as our information reporter, all or spare time, $25 to $100 per month. Nothing to sell. Send stamp for particulars. Press Association, 79 Associated Bldg Indianapolis, Indiana.

INQUIRY COLUMN

READ THIS COLUMN CAREFULLY.—You will find inquiries for certain classes of articles numbered in consecutive order. If you manufacture these goods write us at once and we will send you the name and address of the party making the inquiries. There is no charge for this service. In every case it is necessary to give the currency of the inquiry. Where manufacturer do not send catalogues, the inquiry may be repeated. MUNN & CO., Inc.

SWAN'S
Fountain Pen
For XMAS
Is a gift that is appreciated by men, women and children the world over Made in chased vulcanite, sterling silver (filigree or engraved) rolled gold and solid gold in different styles

The "Gold Top Feed" which shows on the upper face of the nib in the illustration, keeps the pen moistened with ink at all times and insures instant writing

The "Ladder Feed" on the under face of the nib, as the cut illustrates supplies the ink steadily without skips, blots or overflow of ink.

The "Screw down Cap" is a device that screws down tight over the nib, creating an ink tight chamber, making it impossible for the pen to leak

SWAN Safety Pen

Can be carried in your pocket, suit case or handbag in any position, horizontally or upside down The "Swan Safety" will never leak.

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and reduction of the liquid and solid matter, to insure complete combustion of matter and utilizing products of combustion for heating boilers for generating steam to be used partly in the furnace, and a supplus for power purposes for the production of electric lighting, etc.

PYROPHORIC METAL ALLOY.—G F HOFMANN Bayerstrasse 87 Munich Bavaria Germany In accordance with this invention the pyrophoric metallic alloy of manganese and antimony has only added to it a small quantity of metallic cerium for instance, about 5 per cent of metallic cerium suffices to considerably reduce the hardness of the manganese antimony without injuring its pyrophoric property It sparks better than the simple antimony and manganese alloy it is more easily fled and remains unaltered in the air

FOLDING TOOTH BRUSH.—S. B LUTICA, 400 Columbia Bldg Portland Ore This invention relates to tooth brushes, and it has for its purpose one which may be folded and carried in the pocket, the device having a box for containing tooth powder which is permitted to reach the brush member pivoted to the box through an opening therein

BAIT FOR CATCHING ANIMALS AND THE LIKE.—C. H FRETER Laddonia Mo In the use of this composition the same can be used in connection with any common animal bait, such as meat and the like or the composition can be used alone When used in conjunction with animal traps it serves to attract the animal to the trap and in this manner presents an efficient and easily prepared bait.

Hardware and Tools.

WRENCH.—A. BRAUN Kopprasch Agent, Vienna Austria Hungary The is made of a handle provided with a jaw extending at an angle from the handle and having thereon a gripping ing for engagement with the peripheral surface of an object to be turned or adjusted and a second jaw provided with a gripping ing for engagement with the peripheral surface of the object, the said second jaw being pivotally mounted on the handle and in contact with a spring mounted on the handle.

DESK REMINDER.—G W WRIGHT Schoeuer Bldg 788 Broad Street Newark N J An object of this inventor is to provide a device which will hold a plurality of memorandum tabs in separate readily accessible positions whereby they can not nly be readily removed and inserted but also can be at least partially visible so as to be distinguishable one from the other

WRENCH.—EDWARD L. BROWN Box 89 Virginia City Nev This engraving presents a side view partly in section of a wrench showing the jaws open The handle may be preferably of metal channeled out in its sides. The tapered forms of jaws are useful in that they will hold the end of the wrench on the pipe after the jaws are adjusted and there is no danger of their slipping off The said



PIPE-WRENCH

ing jaws may be adjusted to fit upon a pipe by turning the screw and the last may be slacked to allow play between the jaws so the wrench will work freely around the pipe, and if very thin the throw of the sliding jaw can be regulated so as not to crush the pipe The inventor will communicate with reliable parties on request in relation to manufacturing the wrench on a royalty basis

Heating and Lighting

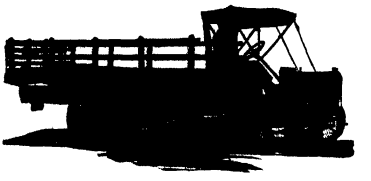
WARM AIR REGULATING HEARTH.—E B LORACH 4715 Haywood Place Denver Colo In this structure the inlet opening for warm air is adjacent the bottom of the hearth and is covered by a plate which has a portion of its surface perforated to permit passage of the warm air from the inlet pipe through the hearth into the room or apartment. The perforated portion is controlled by a slide or damper which uncovers a greater or less number of the perforations as desired

FLEXIBLE PIPE COUPLING.—W A CRAMOND 387 E 19th Street, New York N Y The invention relates to improvements in pipe couplings for use generally in connecting relatively—movable pipes through which a fluid is delivered, the special form of coupling being designed for use in connecting steam pipes which carry the steam to multiple waterless cups of telescopic gas holders, to prevent the freezing of the water within the cups during winter

Household Utilities.

BATH ACCESSORY.—F HESS, 321 Fifth Avenue West, Kalispell, Mont. This invention provides a sanitary towel supporting frame to be readily adjusted to a bathtub of usual construction the frame being provided with means for securing the towel firmly in the frame; and provides a device adapted for attachment to the inclined end of the bathtub.

TOWEL FRAME BRACKET.—W. J. DALE, 314



What Motor Trucks Mean

IF you are not using motor trucks, we take it for granted that you do not understand the benefits to be derived from them Possibly you have the wrong viewpoint—perhaps you have been making too many comparisons with the horses and not really investigating what the truck meant to you as a machine to perform certain work The individual or firm that has a better delivery system has an advantage—the kind of business doesn't matter—service is appreciated universally If The White Company can place in your hands a more efficient means of making deliveries, they have given you an opportunity of extending your field—of broadening the horizon of your product—of making good—where you had been unable to go before

White Trucks Known for Performance

GO into any large city in the United States—ask the men who have the largest delivery problems, to see what they know about these White trucks Almost regardless of whether they own them or not, you will find that they know their record for splendid performance To the man about to invest in trucks, a list of White owners will appeal as almost a directory of the big business men They have invested their good money in White trucks and their endorsement is the fact that they are continually increasing their equipment No one buys and buys again the thing that fails to stand the test We could tell you why—because it is all in the designing—in the building—in the care we take in the production of the truck The important thing to you is that they do perform—that White trucks satisfy their owners—and, therefore, must be the kind that you want

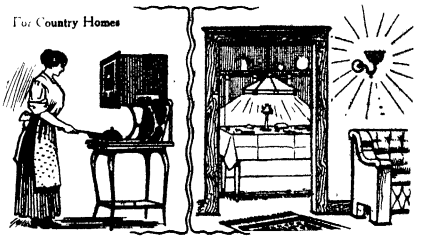
1500-lb delivery wagons 1½-ton 3-ton and 5-ton trucks—all with a universal type of power plant

Let us submit a solution of your delivery problem It will entail no obligation

The White Company

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For Country Homes



Cooking Fuel and Illuminating Gas
Made at Home with a Little Machine Like This

ABOUT once a month this machine must be refilled with gas producing stone and wound up like a clock.

When obediently it stands idle until you start to cook or turn on the lights

Then, with no attention whatever, it gets busy and makes gas automatically—just enough to keep your stove and your lights going

The stone, known commercially as "UNION CARBIDE," gives up its gas when the machine drops a few lumps into plain water—a little at a time as the gas is wanted.

The gas is genuine Acetylene Burned in handsome chandeliers it gives a flood of brilliant pure white light

Burned in the kitchen range, it makes a hot blue fire that can be instantly turned up or down, on or off.

For both cooking and lighting it is used exactly as city gas is used by over twenty million city people.

As a fuel, it flows right into your stove without handling and burns without soot or ashes

As a light, its white, sunlike beauty is unrivaled Reflected from handsome globes suspended from brass or bronze chandeliers, it supplies the up to date city like appearance of refinement and elegance which the average country home lacks

Moreover, it is not poisonous to breathe, and the flame is so stiff the wind can't blow it out.

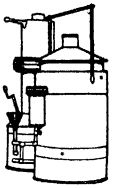
The UNION CARBIDE you dump in the machine once a month won't burn and can't explode

In a nutshell, one of these gas machines installed in the cellar or an out building of a country home solves the *lighting* and *cooking* problems for all time

And they are so easy to install in any home without injuring walls or carpets that there are now over 180,000 Acetylene Gas Machines in actual use

We manufacture and our agents arrange for installing thousands of them every month in all parts of the world.

There are, of course, many crude imitations of our machine on the market, but the genuine is easily distinguished by its name and our trademark



"Pilot" Acetylene Generators



On the first return mail we will send you free literature telling how Cornell University has been growing plants by our light—why oculists recommend it for eye strain—why the Insurance Engineers pronounced it much safer than kerosene—how this lights can be placed in barns and outbuildings—how they can be equipped to light up without matches—and how the gas range shortens kitchen hours and makes cooking a pleasure.

With these booklets telling all this wonder story, we will send figures showing how little a "PILOT" lighting and cooking equipment will cost in your case.

Just write us how many rooms and buildings you have to light and where you are located. Address your letter to the ACETYLENE APPARATUS MFG CO—South Michigan Avenue, Chicago, Illinois.

HOW TO BUILD A 5 H. P. GAS ENGINE AT HOME

In *Scientific American Supplements*, 1641 and 1642, E. F Lake describes amply and thoroughly how a five horse power gas engine can be built at home. Complete working drawings are published, with exact dimensions of each part. Price by mail for the two Supplements, 20c. Order from your newsdealer or from

MUNN & COMPANY, Inc. *Publishers* 361 BROADWAY, NEW YORK



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The pictures of the two drawers at the left, tell the story. The one drawer is crowded with sagging mass of unsupported folders—in getting them back, papers are easily crumpled and torn.

The other drawer has our *Patented Inside Metal Partitions*, which do away with crowding and sagging, and always keep the *folders upright* and easy of access.

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No Waste Space

Multoplex Cabinets save money and set a new mark of filing efficiency.

They enable more rapid filing of folders—
—permit correspondence to be found and taken out more quickly
—prevent crumbling tearing and mutilating of letters
—reduce the number of misfiled and lost letters
—permit drawers to be filled to capacity without overcrowding
—effect a big saving by doing away with guide cards and permitting the use of lighter, less expensive folders.

Write for Our Booklet—"Faultless Filing"

Learn the full particulars about these new filing features that mean much greater efficiency at less expense. Please mention your firm name and in what capacity you serve. Write for the booklet today.

CANTON MFG. CO., 1204 S. Second St., Canton, Ohio

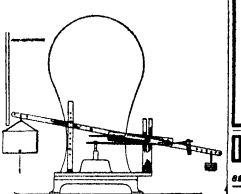
N Main Street, Mason City, Iowa. This invention is an improvement in sink frame brackets, and the aim is to provide a bracket which is especially adapted for supporting sinks, and which may be expanded or contracted, to fit sink frames of varying sizes, and wherein means is provided for locking the parts in adjusting position.

WATER CLOSET FIXTURE.—T. F. WARD, care of T J RYAN, 6 Howard Street, New York, N Y. In the present invention the principal object is the provision of a fixture for the usual water-closet bowl, which automatically closes over the bowl to prevent the emission therefrom of disagreeable odors or sewer gas, and to conceal the interior of the bowl.

Machines and Mechanical Devices.

ATTACHMENT FOR SHUTTLES.—G. PAVIA, Allentown, Pa. This attachment severs the thread so as to prevent damage, when an unusual pull is had on the thread. The attachment may be secured to shuttles in ordinary use, which may be set so as to allow the thread to feed from the bobbin just so long as the loom is working properly, but when, from any cause an unusual pull is had on the thread or a knot or tangle in the thread reaches the attachment, the thread will be automatically severed so that the shuttle will run free

AUTOMATIC RAM STARTER.—J. F. T. BJERKNAES, St. Paul, Ore. The object here is the provision of means in connection with the ram for opening the impetus valve to stop and start the same in accordance with the head of the water, stopping the ram when the water falls below a predetermined point and starting it when the water has a sufficient head The illustrated figure shown herewith represents a side view of the improvement, the ram of which is of any usual

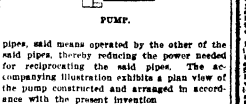


AUTOMATIC RAM STARTER.

or desired construction and the impetus valve thereof is contained in the chamber at the base of the ram

FLYING MACHINE.—E. J. CRAWFORD, 1208 N 45th Street, Seattle, Wash An object of this invention is to provide a lighter-than-air machine which is provided with a safety device so as to prevent a rapid descent which might injure the aviators This device is in the nature of a parachute which may be shifted so as to sustain the flying machine so that its descent will be gradual

PUMP.—KARL F. GERHARD, Hatton, Wash The principal object which the present invention has in view is the provision of a pump having mutually balanced stand pipes of indefinite length, the said stand pipes being each provided with pumping means for increasing the height of the column in each of the said



PUMP.

pipes, said means operated by the other of the said pipes, thereby reducing the power needed for reciprocating the said pipes. The accompanying illustration exhibits a plan view of the pump constructed and arranged in accordance with the present invention

SPUDDING DEVICE FOR WELL-BORING MACHINES.—G. P. RIGGS, Box 411 St. Mary's, West Va. This invention provides a boring bit reciprocating device having an amplified stroke and mechanism for operating the same, provides means for reducing the rotation of the lifting sheave and the travel of the drill rope thereon, without diminishing the stroke thereof, and provides an extensible rigging for boring operations.

NECK GROOVING ATTACHMENT FOR BOTTLE MOLDING MACHINES.—E JOHNS, 611 Walnut Avenue, Fairmount, W. Va. Primarily, this invention consists in providing a separate mechanism for grooving the neck of a bottle, mounted upon one or the other of the primal molding tables, to impart the groove in the glass prior to its initial blocking, thereby avoiding reheating.

AEROPLANE.—C. M. WARNER, Urbana, Ohio. This inventor provides a substantial

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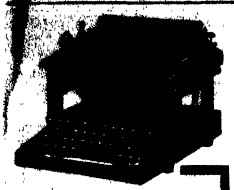
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whereby aeroplanes are enabled to start their flight from a resting position; provides means for mechanically lifting the aeroplane to an inclined position while in contact with the ground or starting station and provides manually operated mechanical means for initiating the flight of an aeroplane.

DRILLING MACHINE.—K. L. J. FRASER, Sandpoint, Idaho. The aim in this case is to provide a machine more particularly adapted for drilling holes in tree stumps and the like, preparatory to blasting the same. Further, to provide a machine mounted to swing on a frame, so that the drill can be used at various angles and positions, depending wholly upon the work to be drilled.

Railways and Their Accessories.

SELECTIVE SWITCH MECHANISM.—A. V. MCFARTLAND, 16 Perry Street, Newark, N. J. This invention has reference to a device whereby the motorman on a car as he approaches a switch leading to a plurality of different tracks, can operate a mechanism on the car which actuates the switch so as to divert the car in the direction in which he desires to go.

SAFETY APPLIANCE FOR AIR BRAKES.—A. B. LEETWICH and C. N. MARKLE, 1413 E. 7th Street, Pueblo, Colo. The object here is to produce a brake which is simple in construction and which can be controlled in its operation by pneumatic means, a more specific purpose being to provide mechanism whereby a brake is held unapplied by pneumatic and mechanical means, and is applied by spring pressure when pressure in the service or train pipe is sufficiently reduced.

Pertaining to Recreation.

GUN.—AUGUST REISTEIN, 48 Stuyvesant Street, New York, N. Y. The purpose of this invention is to provide a new and improved gun, arranged to permit of conveniently turning the barrel of the gun in a horizontal plane for taking the desired aim, and to permit the



GUN.

user to readily propel and retract a striking or a shooting plunger without danger of disturbing the aim. For the purpose mentioned, use is made of a barrel containing two spring-pressed plungers, of which one on being released actuates the other plunger. The engraving herewith gives a view of the longitudinal central sections of the gun.

TOY.—T. D. FLOTO, Box 17 Station S, Brooklyn, New York, N. Y. This invention relates to toys having a ball or roller adapted to wind up and unwind on a cord held at one end by the user of the toy. The object is to provide a toy in which the ball is rendered exceedingly smooth, and the necessary weight is provided to insure a proper unwinding of the ball and re-winding on the cord by the momentum caused by the unwinding of the ball.

Pertaining to Vehicles.

VEHICLE TIRE.—F. A. SCHULTZ, care of Mattson Rubber Co., Lodi, N. J. Among the principal objects the invention has in view are to provide a resilient filler wherein the air contained in the tire is circulated to prevent local overheating of the tire casing and filler, to provide auxiliary resilient members adapted to augment the carrying capacity of the tire and the resilient quality thereof; to provide a filler for an automobile tire formed from a number of removable and renewable sections, rendering the tire capable of economical and simple repairs; and to provide means to release or imprison the locking members of the tire, and to augment its resiliency.

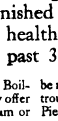
AUTOMATIC CRANKING MECHANISM.—J. P. PETIT, 873 N. Commercial Street, Salem, Ore. The improvement is in cranking mechanism or devices used on automobiles, and the aim is to provide a novel construction whereby the engine can be cranked from the driver's seat of the car in a perfectly safe manner, and by means which will avoid the possibility of any injury to the driver by the action of the engine.

ROAD MACHINE.—M. M. SIGMUND, Pala, San Diego Co., Cal. This invention provides a scraping blade and supporting means connected directly with the draft team or mechanism; provides carrying wheels and means for varying their angle of operation; provides for the carrying wheels a supporting table the operation whereof serves to vary the lift of the body by adjustment of the said wheels; provides carrying wheels and mechanism therefor whereby the same may be turned to vary the angle of a scraping blade; and provides carrying wheels and body structure adapting the machine to be turned upon a self-contained center.

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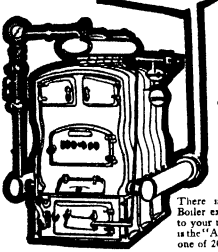


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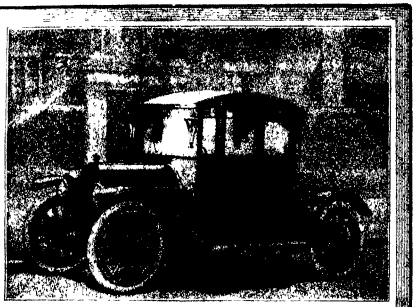
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Needed Reforms in Patent Procedure

(Concluded from page 454.)

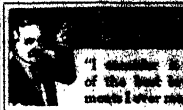
or seventy-five dollars a day for their services in preparation and while testifying, it can readily be seen how enormous the expenses of patent litigation may become under this mode of producing evidence. The system places the poor inventor at the mercy of his rich adversary and, sad to relate, renders it possible for lawyers with easy consciences to protract examinations for the mere purpose of multiplying *per diem* charges.

The impression should not be gained, however, that this system of producing evidence is peculiar to patent cases. It extends to all causes brought on the equity side of the court, but its evils are perhaps not so frequently manifested in other classes of cases. There is a universal cry for a remedy. President Taft in his messages to Congress has referred to it. Three members of the Supreme Court of the United States, namely, Chief Justice White, Mr. Justice Lurton and Mr. Justice Van Devanter, have been assigned to look into the matter and have conferred with committees appointed from the bars of the various Circuit Courts of Appeal with the view to ascertaining if something cannot be done by way of curing the evil. No definite result has yet been reached, but it is the expectation of the bar that, at an early day, the General Equity Rules will be so modified by the Supreme Court, under the power given that court by the statute, as to require that the testimony of all witnesses living within the jurisdiction of the trial court shall be taken in open court, in the presence of a judge, and that only the testimony of such witnesses as live beyond the reach of the process of the court (i. e., one hundred miles, or to the limits of the district) may be presented to the court by way of depositions. Such a change of practice as this may, and doubtless will, develop difficulties that will have to be met as they arise, but it is believed they will be met and that the net result will be that the volume of testimony taken will be very much reduced and that generally the dispatch of business will be facilitated and the cost of litigation very materially decreased.

Time and space will permit of an allusion to but one other need of our patent system, namely, the establishment of one great Court of Patent Appeals to which appeals from all the trial courts may go and whose judgments as to the validity of the patent in view of all defenses actually raised against it, will be final and conclusive and, in operation, coterminous with the whose territory of the United States.

At the present time, an appellate court called a United States Circuit Court of Appeals is provided in each of the nine judicial circuits, and while the judgments of this court are final, as to that circuit, they have no force beyond the limits of the latter. The result is, that a patent may after most strenuous litigation, be held valid and infringed in one circuit, and, on substantially the same record, be held invalid and not infringed in another circuit.

Such a condition of affairs has become intolerable and for many years past Congress has been importuned to divest the Circuit Courts of Appeals of their appellate jurisdiction in patent cases and to create a new appellate court for the disposition of all patent appeals. There seems to be a general recognition of the necessity for such a court, but the difficulty of reconciling the various plans that have been suggested and advocated as to methods of organization has so far prevented a favorable outcome. President Taft, in his address to the American Bar Association last August, at Boston, made extended reference to the matter and suggested that the recently created Commerce Court, composed of circuit judges, might take over the jurisdiction of patent appeals and thus solve the problem. It remains to be seen whether his suggestion will be acted upon by Congress. The plan advocated for so many years by the American Bar Association of having a new and independent court composed of a permanent presiding judge and four associate judges selected, because of their demonstrated aptitude to deal with patent cases, from the U. S. Circuit and District benches, would seem to be more nearly ideal.



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Edison's Pioneer Work

(*Concluded from page 454.*)

series with the armature, and could be "plugged" in and out of circuit by the motorman as he needed

In the same year, 1880, the generators were compound-wound for better regulation under changes of load, and three cars were put in commission as rolling stock. One of these was an open car with awning, and two park benches placed back to back Another was a flat car for freight, and the third was a box car, dubbed the "Pullman," on which Edison tried a system of electro-magnetic braking covered by patent The road attracted a great deal of attention, was visited by celebrities, and was freely described in the papers The SCIENTIFIC AMERICAN of June 6th, 1880, gave an excellent account of it, and a little later the New York *Daily Graphic* described also the electric locomotive with six-foot drivers, capable of working up to 300 horse-power, which Edison designed for use on the Pennsylvania Railroad between Perth Amboy and Rahway But President Frank Thomson of the Pennsylvania could not "see it;" nor could his engineers What would they say of the electrified Pennsylvania entrance into New York to-day?

When Edison went out to Wyoming in 1878 with his transmeter to observe and help register the transit of Venus, he had noted the long hauls of the wheat farmers with their grain A drawing of his of May, 1879, shows electric power plants operated out on the prairies by wind power, to give these farmers light electric traction Henry Villard had the same general idea, and in 1881, after this successful demonstration of 1880, joined issues with the young inventor and put up between $35,000 and $40,000 for a trial of the scheme The Menlo Park pioneer line had been extended to a mile and was now made nearly three miles in length in 1882 The construction approximated standards as to gage and material and was solidly built There were three trestles, one of which was nearly 250 feet long and 10 feet high The rails were insulated from the sleepers by two coats of japan varnish baked on them in the oven, and by pads of tarred muslin The ends of the rails were electroplated to give proper contact for copper bonds and fish plates The conductors were underground as before There were two turntables, a freight platform, three sidings and a car barn The line ran through a rural district three miles south to Pumptown

Two new electric locomotives were built, and following the traditional lines of conventionality there were given the full regalia of headlight, cab and cowcatcher Little change except by way of refinement was made in the electrical arrangements from those of 1880 One locomotive was designed for passenger service and weighed five tons, the other for freight, with single reduction gears, weighed about ten tons As many as 90 passengers at a time were hauled by the smaller locomotive in 1882 The contract speed was 60 miles an hour The capacity of the freight locomotive per contract was 10 tons, speed negligible. Mr Villard agreed to enter into negotiations. If the tests were successful, for an initial 50 miles of electric railroad in the western wheat regions, as right-angled feeders to the Northern Pacific line Possibly all this would have been done, but the Villard panic came—and the farmers of the northwestern wheat fields are still without the service that was planned for them, although many thousands of farmers now depend upon trolley lines for getting their milk, fruit, eggs, and other produce to the distant market Edison was a great admirer of Villard; and as the directors of the old Edison Electric Light Company refused to have anything to do with the electric railway or the contract, Edison treated the money advanced from Villard as a personal loan and repaid it out of his own pocket Villard was worthy of such esteem. He was a great leader and pioneer and visualized the whole Pacific Coast development while all America was still looking eastward. At an early moment he believed that the mountain division of the Northern Pacific could be operated electrically, and acting on his request Edison devised a third-rail-and-shoe system such as is now familiar and set it up in his works yard at Orange The steam railroad engineers refused to have anything to do with it as impracticable, and one

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can hardly blame them; but it is here and every year will see more of it.

Edison has never made anything out of all this or other pioneer electric railway work; but that is not a unique experience for an inventor. Had he "stayed in the game" he might have recouped some of his losses financially, but he was very busy elsewhere and the young art was already moving forward with swift and tremendous strides. His first electric locomotive is now a treasured relic at the Pratt Institute in Brooklyn, N Y The remainder of the little primitive system has rusted and faded away, or lies around, as shown, in innocuous oblivion, at one with the pyramids and castles and ancient cathedrals.

Perpetual Motion

(Concluded from page 468.)

Ernest Elie-Bessler Orphyrreus upon what are conceived to have been substantially the foregoing principles. It is related that Orffyreus, as he is generally called, made one machine about 1715, but broke it up because of the tax imposed upon it by the government of Hesse Cassel A second apparatus was made and exhibited to the Landgrave. It is said that this machine, which outwardly appeared to be a drum 12 feet in diameter and 14 inches between faces mounted upon an iron axle, upon being started with a smart impulse—in either direction—would rotate faster and faster until the periphery was moving at the rate of about 16 feet per second. It was claimed, so it would seem, that the wheel having been set in motion in the chamber of the Landgrave and kept there under seal, was still going after the lapse of two months The machine was stopped, so it is said, to prevent undue wear However, the inventor kept his secret very close. The Landgrave, having made him a fine present, was shown the interior But he had to promise not to tell what he had seen nor to make use of his knowledge. In fact, Orffyreus demanded a payment of about $100,000 for his secret Prof 's Gravesand of Leyden was employed by the Landgrave to investigate the machine, in so far as one might be able to do so without opening up the interior. In a letter to Sir Isaac Newton in connection with this matter, he describes it as made of "several cross pieces of wood framed together, the whole of which is covered over with canvas, to prevent the inside from being seen Through the center of this wheel or drum runs an axis of about six inches diameter, terminated at both ends by iron axes of about three-quarters of an inch diameter upon which the machine turns I have examined these axes, and am firmly persuaded that nothing from without the wheel in the least contributes to its motion When I turned it but gently, it always stood still as soon as I took away my hand, but when I gave it any tolerable degree of velocity, I was always obliged to stop it again by force, for when I let it go, it acquired in two or three turns its greatest velocity, after which it revolved for twenty-five or twenty-six times in a minute. This motion it preserved some time ago for two months, in an apartment of the castle, the door and windows of which were locked and sealed"

It seems that no one who had the $100,000 ever agreed to pay it over upon the condition that the apparatus should be "found to be really a perpetual motion" Whether Sir Isaac Newton replied to Prof 's Gravesand or not, I do not know.

A device probably similar to that just described is illustrated in Fig. 9. There is a rotatable wheel upon whose circumference arms are hinged at equal intervals Weights are attached at the outer ends Stops are so arranged that the movement of an arm on its hinge is limited to an angle on one side of which is a prolongation of a radius All the arms are arranged to swing from a radial direction in a circular direction contrary to the hands of a clock. By attending to the figure, it will readily be seen that on the right the weights *A*, *B* and *C* are advantageously situated to produce a clockwise motion, even though somewhat resisted Because of a preponderant advantage which it might seem reasonable to suppose continually to attach to the weights on the right, we might look for perpetual motion.

What may be regarded as a variation from this device is exhibited in Fig. 10. Here the arms consist each of a number

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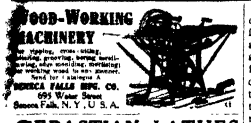
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of links hinged together. A trough *D C* is arranged to permit the weights, which are here loose balls, to roll from one side to the other. This trough is fixed in position. By these means, the weights of the upper left-hand quadrant are entirely removed or brought in close to the vertical diameter When a weight rises to the point *D* it rolls off by way of a trough to an arm previously crumpled up but now outstretched.

The great thing overlooked in such devices is the question of velocity. A ball which falls from top to bottom will acquire, *apart from friction, just so much* momentum This is due to the vertical distance passed over, and will not vary however tortuous the real path may be The reason that it is due to the vertical distance is because that is the direction in which gravitation acts. Similar considerations apply to the upward movement It is the vertical distance that counts because that is the direction in which gravitation has to be overcome Of course, this is precisely the same from top to bottom as from bottom to top

I may be permitted to call attention to a device somewhat similar to those just described. (See Fig 11.) The figures to right and left of the vertical diameter are the same in number As it is obvious that a number of 8's preponderates over an equal number of 6's, the wheel must, of course, turn clockwise. Study this device well, it is as good as any of the others.

The devices described so far all aimed at gaining a balance of power from the effect of gravity. Other inventors have sought to utilize the properties of a mag net for the same purpose.

The oldest of devices of this kind (Fig 12) offered in 1570 by the Jesuit priest, Johannes Theisner, had a lodestone on a pillar, supposedly drawing iron balls up an incline When they reached the top they were to drop into a curved tube which would let them out at the bottom of the incline through a trap door The other three types are all based on what seems to have been the most popular notion of perpetual motion schemes, namely, on overbalancing one side of a wheel to make it rotate Stephan's plan (Fig. 14), dating back to 1789, was to have four cylindrical magnets sliding in holes bored radially into a square wooden block which was mounted so as to rotate between two pivoted magnets of opposite polarity All of these sliding magnets had their north poles pointing away from the center, hence they would be attracted by the pivoted magnet with the south pole at its free end, but repelled by the other Then the corners of the wooden block were supposed to tilt the magnets so as to carry the movement beyond the dead points

Instead of using such a wooden block, the writer in his high-school days proposed (Fig 15) a brass drum rotating close to a horseshoe magnet, with two rods running radially through the drum at right angles to each other Each of these rods was to carry heavy knobs at its outer ends and a soft iron armature inside the drum Then the magnet was to attract the armatures so as to draw out one knob after the other, leaving gravity to return them. Somewhat allied is the still more recent proposal of Korting and Hoepe (Fig 12) that a magnet be used to attract one after another of a series of soft iron pieces connected at their ends by brass links to form a ring and supported by rods which can slide in and out on the spokes of a wheel Of course none of these devices ever worked and some of our readers may be interested in figuring out why

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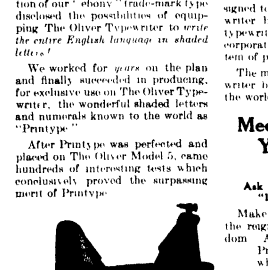
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NAVAL NUMBER

December Magazine Number of the *Scientific American* Issue of December 9th, 1911

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The period of American history which opened with the Spanish war will always be reckoned as one of the most momentous in the growth of the United States

As the immediate result of the Spanish war and our acquisition of Hawaii, the Philippines and Porto Rico, our Navy assumed an importance which it had never before held. The growth of our fleets since 1898 has been steady

During this period the Scientific American has lent its pages freely to the work of describing the growth of our Navy, and we believe that the intelligent interest in the Navy and its undoubted popularity have been due in no small degree to the efforts of this journal. As a fitting climax we are in a position to announce that on December 9th, we shall issue a magazine naval number, which will be written entirely by leading officials in the Navy, each of whom stands at the head of the particular branch of the service of which he treats.

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The World Patent

To the Editor of SCIENTIFIC AMERICAN:

Your article in the issue of September 9th, 1911, on "The World Patent" is very interesting, and should pave the way to the realization of said object. A universal patent would be a great benefit to the industrial world, which you so cleverly photograph, and you as a leading scientific journal of this country should take up this subject and follow it with the same ardor and energy with which you are following the naval, aeronautical, and other important fields. Your devotion to this subject should influence activity in other quarters, resulting in the realization of said universal patent. The obstacles to the realization of said universal patent may appear great, but they can be easily removed by the concentrated efforts of the inventive or patent world and the countries forming the International Union. To this end I take the liberty to humbly offer a few suggestions. The effectiveness of a universal patent depends very much upon the support given to the matter by all the countries of the International Union as well as by many of the other countries not yet members of the union. To further make a universal patent effective, it must be issued at one predetermined place to the subjects of all the countries favoring such patent rights union. As most of the countries would desire to have some control over their patent business, the most effective plan may be to have universal patents issued by an international patent office, and working patents issued independently by each country, as will be seen hereafter. To insure the validity of a universal patent, a system of examination and record must be instituted at one predetermined place, whereby all the patents issued heretofore or to be issued by the countries of the union could be thoroughly traced and examined when necessary. For the above purposes an international patent office should be established at a predetermined place, where all patent applications are to be filed, examined, issued, contested, or adjudicated. Said international patent office can have within its system a judiciary board for the consideration of lawsuits connected with said patents. Said international patent office constituting a centralized industrial bureau, should have in every important branch of its service *attaches* from every country a party to the union. Within a predetermined length of time, each country forming a part of the union could have filed with said international patent office complete records of all the patent transactions of said country. The international patent office should issue a universal patent, representing certification of examination, for any invention found after due searching and examination to be entitled to same. Said universal patent in turn shall command the issue of a working patent (without any further examinations or objections of any kind) in each of the countries of the union in which application therefor be made, the two patents constituting the complete patent in each respective country. To defray the working expenses of said international patent office, a predetermined fee should be paid for each patent application. Such universal patents could be issued for twenty years, and could be made renewable for an additional number of years after the payment of additional taxes. A suitable tax should be paid to the country of which the applicant is a citizen, upon the issue of a working patent, and only half of such tax should be levied by each other country in which a working patent is secured. The validity, as to priority and patent rights, of a universal patent shall be absolute in all the union countries and subject to formulated laws, rules, regulations, and decisions of the patent office, but the working of a patent in any one country shall not be allowed before securing a working patent. For efficiency and uniformity, a language to be used for the international patent office transactions should be determined upon. Universal patent cases may be judged in any country of the union in which the case arose, but the decisions rendered should be subject to ratification by the board of justices of the international patent office, for which express purpose such board should be created. The above plan could be placed in working order within five years from its adoption, without interfering with the operations of the various existing patent offices. Since the United States issues the greatest number of patents, it is entitled to be designated as the home of the International Patent Office, second in choice being Great Britain or Germany. For a central location England or France may be preferred. An alternate plan would give the International Patent Office the power to issue a universal patent valid in all countries of the union without the additional working patent. Such plan, however, would be more difficult to realise at the present time, since it would centralize in the International Patent Office all the powers and authorities of record, examination, and guaranties also absolute justice, instead of having this International Patent Office as an examining department for all the union countries and as a composite board of record-based justice, as it is essentially intended to be.

H. B. T.

Philadelphia, Pa.

Music a Palliative and Restorative in Cases of Nervous Prostration

To the Editor of SCIENTIFIC AMERICAN:

The readers of the SCIENTIFIC AMERICAN would doubtless be interested in a few incidents illustrative of the effect of music on the mentally sick. The Georgia Sanitarium for the insane has been making experiments along this line of thought. While the results thus far collated are not demonstrative nor conclusive, they are suggestive.

An instance of the palliative influence of music came under the writer's immediate observation. A patient with acute nostalgia (home sickness) on hearing a Stella grand piano music box, that was presented to the sanitarium for research work, immediately wrote home: "The nostalgia is gone. It is no longer acute home sickness with me. There is a Stella music box here that is health, happiness, heaven." A clergyman with chronic aphasia (inability to command words) on hearing the same instrument, summoning his will power in one supreme effort to speak, exclaimed, "That Stella is a star when it comes to music! I have been praying to die that I might go to Heaven, but Heaven is in that Stella music. Bless you, friends! What am I doing? I have lost my aphasia, the music of Heaven has given me my tongue again." A lawyer whose melancholia was complicated with acute nostalgia attended a number of musical entertainments that diverted his thoughts into new channels, and gave surcease to his imaginary troubles. Within thirty days he retrieved his former standing and was appointed a superior court judge.

The *rationale* or explanation of these marvelous results is apparent. The resuscitation or restoration of the will power by means of the emotions, or the addressing the will through the media of the emotions that make their appeal through music. The language *par eminence* of the emotions is music. Good music conduces to the restoration of the nervously prostrated by diverting the mind from brooding over imaginary troubles. By a soothing influence exerted upon the nerves, it calms the perturbed brain tissue, and acts as a stimulus, vivifying partially atrophied faculties, and inspiring hope, the hope that the melancholiac may yet accomplish some great achievement.

Owing to the fact that the State has all it can do to provide the absolute necessities of life for its three thousand insane, there is no appropriation for musical instruments. We are therefore under the necessity of laying these facts before the philanthropic with an invitation to cooperate with us in further research work. The State will pay express charges on small boxes marked "Georgia State Sanitarium Library." Large boxes containing orchestrions, phonographs, player-pianos, or other automatic musical instruments should have express prepaid and be addressed to the writer at the musical department of the State sanitarium. A large cathedral organ would facilitate the work of research. We are not averse to second-hand material.

Rev. Jesse H. Aaron,

Milledgeville, Ga.

SIXTY-SEVENTH YEAR

SCIENTIFIC AMERICAN

THE WEEKLY JOURNAL OF PRACTICAL INFORMATION

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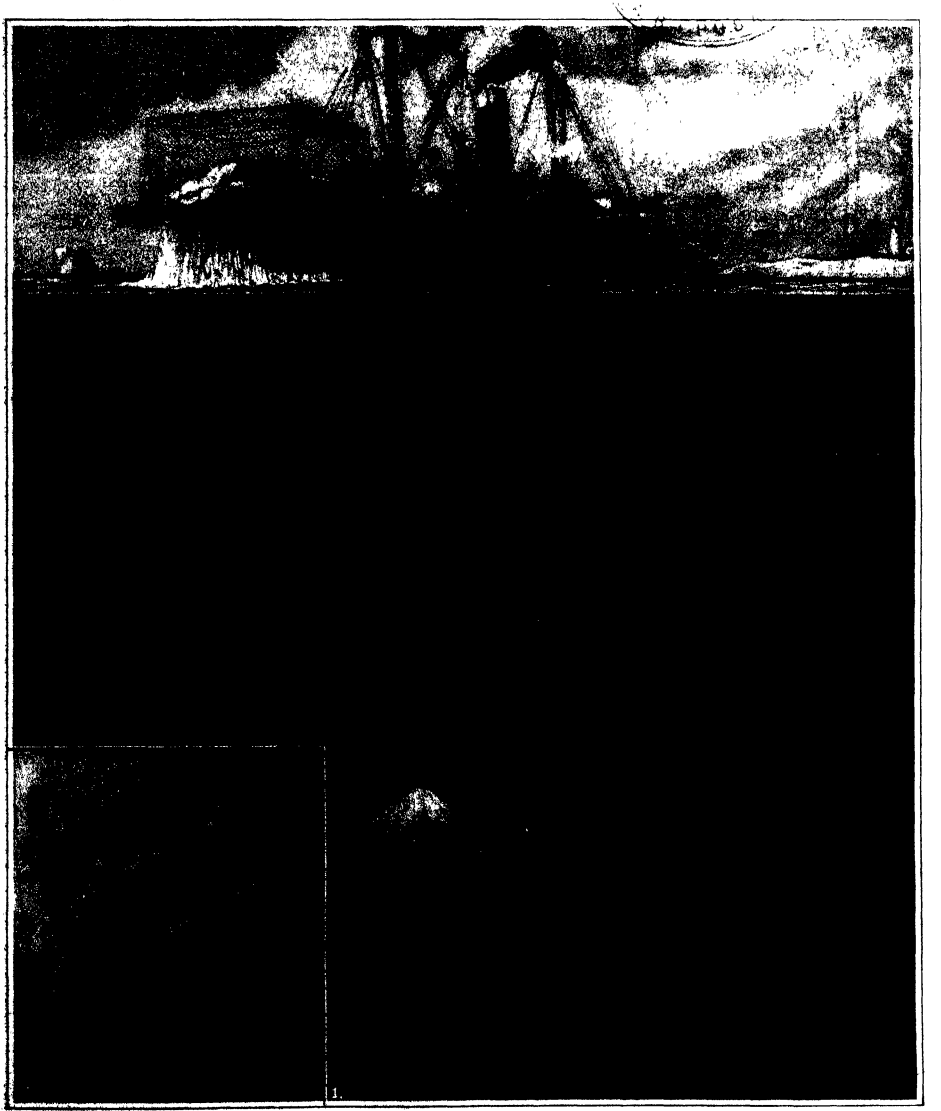


Fig. 1. A composite illustration of the wreck shortly after stranding, but buried under the present forty feet of overlying sand. This view also shows the salvage equipment now employed. Fig. 2 is a cross-section amidships showing where the National Salvage Association is now working. This view represents the "Lutine" at the time she struck. In the course of years the heavy weights have broken through the ship's side and now lie outside.

PUMPING GOLD BULLION FROM THE SEA.—[See page 473.]

SCIENTIFIC AMERICAN

Founded 1845

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The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are strong, the article short, and the facts authentic, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

The purpose of this journal is to record accurately simply, and interestingly, the world's progress in scientific knowledge and industrial achievement

A Fatal Omission

IT is characteristic of the ineptitude which has lately characterized the handling of the subway situation that the present plans, which contemplate the expenditure of several hundred millions of dollars, make no adequate provision for connecting the subway system with the new Pennsylvania station in this city.

We remember that one of the most important sections of the exhibit of the Pennsylvania Railroad Company at the St Louis Exposition in 1904 was an unusually fine model of the then proposed North River tunnels and the great terminal station in the heart of Manhattan Island. The sectional model of the station showed at the easterly end of the building a four track subway, with easy approaches thereto from the arrival and departure platforms of the express and local trains of the company.

Now when the Pennsylvania Company embarked on the vast undertaking involving about one hundred million dollars expenditure, which has resulted in giving Manhattan Island direct steam railroad connections with the West and with Long Island, it was on the understanding that the city would build a subway down Seventh Avenue, and the company received every reasonable assurance that by the time their station was completed the city would be in a position to bring to the gates of its terminal and distribute the many millions of passengers, both suburban and long distance, that would have occasion to use the Pennsylvania system.

The Pennsylvania Company have 'made good'—the city has done nothing. Nay, not only has it failed to live up to a most urgent moral obligation, but in the plans for future subway extension, it has ignored the Pennsylvania terminal altogether.

The case is bad enough as regards the railroad company, but it is infinitely worse as regards the interests of the public, and when we say the public we have in mind not merely the residents of New York, but those of every city in the United States who may have reason to enter or leave New York over the lines of this company.

For the situation which confronts the traveller at the close of his journey to New York is both annoying and ridiculous. If he have any conception of the cost and importance of great engineering works (and every intelligent and informed citizen has this) he will realize, as his Pullman car sweeps through the great tunnels beneath the Hudson River and emerges in the noble station building that only a combination of the highest engineering ability and a far-sighted and wealthy management could have planned and carried out a work of this magnitude solely for the purpose of placing the passenger, with all possible expedition and comfort, in the very heart of the great city.

Having disembarked upon the incoming platforms, he naturally inquires which stairway or tunnel walk will take him to the platforms of the world-renowned New York city subway. To his astonishment and chagrin, he will discover that as far as rapid transit in the city itself is concerned, he has been deposited several city blocks from nowhere. After tramping down a cross street, he will find himself, with the majority of his fellow passengers, standing without shelter from wind or weather on a street curb awaiting the next car of a not-too-frequent service. Then, after something less than a mile of strap-hanging, our grip-encumbered passenger will reach the coveted subway.

"Verily," he will say to himself, 'this mountain in labor has brought forth a mouse."

This is the very anti-climax of transportation!

Nor is it sufficient answer to say that the traveller can take a "taxi." There are millions of passengers using the new Pennsylvania depot who cannot afford the "taxi," and must perforce make use of some five-cent fare system of transportation, such as the elevated or subway system. The objection is particularly strong when taxi rates stand at the present exorbitant figures.

What with plans and counter plans of rival transportation companies, of boards of estimate, of the Public Service Commission, and of individual city officials, this subway matter has gradually got itself into such a complicated "snarl," that we freely confess we long ago gave up as hopeless the attempt to keep in any intelligent touch with the situation. But of this much we are certain, that in failing to make any provision for running at least one of the subway lines through or by the new Pennsylvania terminus, the city has been guilty of the most serious blunder that it could have made.

We believe, however, that the case is not entirely hopeless, and that a way can yet be found to re-arrange the contemplated plans so as to enable travellers who wish to enter or leave New York city by way of the Thirty-third Street terminal to do so without the inconvenience, irritation and considerable loss in time which are incurred under the present conditions.

"The Last Word"

WE have received from a correspondent, who is a leading shipbuilder of this country, a clipping from one of the great London dailies, in which, under the caption of "The Last Word," its naval correspondent makes some rather startling comments on the gunnery trials of the English super-dreadnought "Orion"—the first ship to mount a battery of guns heavier than the 12-inch.

We gladly act on the suggestion, for the reason that the criticism made by this naval writer is based upon a popular error which we find to be very widely distributed. We refer to the suggestion, which amounts to a belief with a great many people, that the firing of the main battery of a warship—particularly of all the guns be fired together in a salvo—imposes such severe strain on the structure of the vessel as to weaken it even to the point of destruction. "The best brains in England," says the naval correspondent, "are perhaps unable to devise a structure capable of standing the terrific shock of ten 13·5-inch guns fired simultaneously."

Later, in the same article, this writer delivers himself as follows: "There is some reason to believe that there is truth in the theory advanced by some that, so far as our present knowledge goes, eight 12-inch, six 13·5-inch, or four 15-inch, represent the utmost broadside that we can build any ordinarily-sized ship to stand with certainty. Anything over this ratio, they say, is useful for paper comparison, and may possibly survive an action long enough to be of material service, but the time dismally prophesied in the past, when naval warfare would not mean a ship resisting the blows of the enemy so much as surviving her own gunfire, seems (possibly) near at hand."

It may be stated once and for all that this "bugaboo" of the harmful effects of the firing of a ship's heavy guns upon the ship itself is without the slightest foundation of fact. Indeed, the stresses set up in the ship as a whole by the recoil of its batteries are almost insignificant compared with those which result from the action of the sea in heavy weather.

The writer remembers how, when the "Lusitania" was being driven at 25 knots into a heavy Atlantic gale, the two ship joints where the upper deck structures had been cut through to allow for the longitudinal bending of the ship as she rode over the waves, showed a movement of fully one inch. Rough calculations showed that the deflection of the ship, considered as a beam, must have amounted to twelve or fifteen inches. Now our battleships have reached a length of between five and six hundred feet. Their decks are not cut as are those of the Atlantic liners, and it will be realized that when they come to be driven hard into a head sea, carrying, as they do, the heavy concentrated loads of the turrets, they will be subjected to stresses of an extremely heavy character.

But all of these conditions are well known to the naval constructor, and the working out of the stresses due to firing the heavy guns forms only a part of the many calculations which he makes in proportioning the different parts of a ship's structure. The energy of the recoil of a 12-inch gun is accurately known. It is transmitted from the trunnions through the girders of the gun carriage to the turntable, and from the turntable through the barbette structure to the framing and plating of the ship. All of this structural material is given such extra strength as may be necessary to take care of these recoil stresses.

During his recent stay with the Atlantic fleet, the writer took occasion, on board the "North Dakota," to go through such portions of the ship as would be most affected by the recoil and examine the paint for those cracks which in a ship are the earliest evidences of straining of the structure. This he did both after the heavy gun practice by day and practice with the 5-inch secondary battery by night, and in neither case was there the slightest sign that the structure of the ship had been affected. The ships of our navy can fire their whole broadside just as long as the ammunition supply holds out and with never a thought as to its effect upon the ship itself.

Hobbs' Theory of Continental Glaciers

AN ingenious hypothesis in regard to the history of continental glaciers and their relation to atmospheric phenomena has been worked out by Prof. W. H. Hobbs.

There are at present two of these glaciers, one of which covers Greenland and the other Antarctica. These great ice sheets differ in many important particulars from the mountain glaciers of lower latitudes. In the latter the land surface always projects above the highest levels of the ice and snow, the glaciers occupying only the hollows and troughs of the mountain slopes. The continental glacier, on the other hand, blankets practically the entire rock surface, except at the margins forming a flat dome; its model is independent of its basement, and its movement is independent of the grades of the underlying floor.

A peculiar system of winds prevails over each of the polar ice caps, in which the distribution of barometric pressure appears to play no part. The winds blow radially outward from the center of the polar continents, i. e., they flow down the ice slopes, often with great violence. Usually of sufficient strength to lift the dry granules of snow a couple of feet or more in the air, when the wind develops greater strength the drifting snow rises to the height of a man, and during the characteristic polar blizzards is probably carried to heights of 100 feet or more above the ice surface; yet the direction is always and invariably outward from the center of the dome. On the other hand, the upper air currents, as shown, for example, by the drift of smoke from the volcano Erebus, in the Antarctic, and by the movement of cirrus clouds, are in the opposite direction, i. e., toward the interior of the continent. Normally drifting from the northwest, when the outward flow of surface air assumes great violence the smoke of Erebus swings around and moves directly south, with an accelerated velocity, as if the upper air was being drawn strongly inward to replace outward movement in lower levels.

These wind systems are explained as follows: Each of the great ice sheets cools the air in contact with it, and the cold and heavy air drains down the slopes of the polar continent. The upper air is drawn down in the central vortex to replace it. Thus air comes from a region charged with ice particles, i. e., from the level of the cirrus clouds. The descending air warms adiabatically, according to a well-known law; its ice content is melted and vaporized, only to be condensed again when the cold surface of the glacier is approached. Thus the glacier is fed entirely by the moisture of the upper air. This is the opposite of the process that occurs in the case of mountain glaciers. In the latter the surface winds blowing up the slopes are adiabatically cooled, and the glacier is fed by the moisture which they discharge.

The fine dry snow deposited over the interior of the continental glacier is continually swept down the slopes, forming the rounded, dome-like surface.

According to this view, the old theory of two polar anticyclones must give place to that of two continental (glacier) anticyclones, the centers of which—the wind poles of the earth—are not coincident with the geographic poles.

In Pleistocene times the vastly larger ice sheets must have given rise to correspondingly vaster permanent anticyclones. Direct evidence of a Pleistocene anticyclone has been obtained by Prof. Solger of Berlin, who in studying the fossil sand dunes of the North German plain, has shown that the prevailing winds at that time came, not from the west, as they do to-day, but from the east.

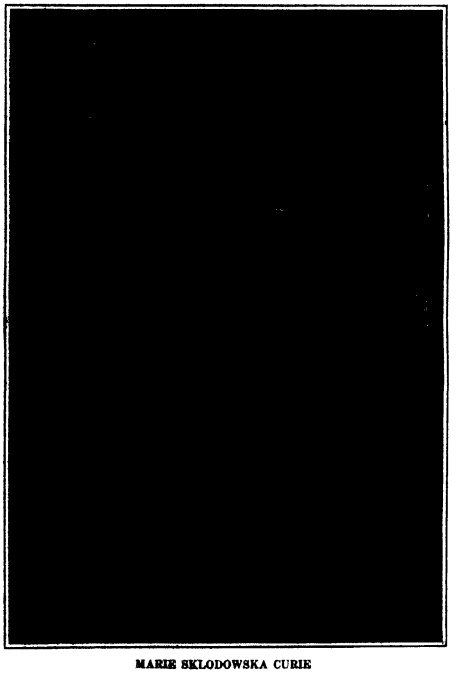
Marie Sklodowska Curie

The Greatest Woman Scientist, Twice Recipient of the Nobel Prize

FEMINISM very nearly won a great victory in the French Academy of Sciences on January 23rd, 1911, when, in the election of a successor to the deceased academician Gernez, Marie Sklodowska Curie was defeated by two votes. At a joint meeting of the five academies which compose the Institut de France, a majority had opposed the admission of women, as contrary to tradition, but each academy was left to decide the question for itself.

The Academy of Fine Arts had a few women members long ago but the Academy of Sciences has never admitted a woman. It was, perhaps, the opposition of the anti-feminists that induced Mme. Curie to apply as a candidate for the chair in the section of physics left vacant by Gernez, and formerly occupied by her husband and collaborator, Pierre Curie. In the preliminary grading of candidates Mme. Curie was placed alone, in the first grade, while her competitors, five eminent men of science, were assigned to the second grade. Mme. Curie, however, received only 28 of the 65 votes (the Academy consists of 66 members), while 30 votes were cast for Edouard Branly. There were good reasons for this choice, entirely apart from considerations of sex. Branly is a physicist of world-wide celebrity who, unlike Mme. Curie, has received few honors and emoluments. He invented the coherer for the detection of electric waves and to him Marconi's first wireless message was addressed. Many of the academicians naturally desired to recognize the very important part played by their compatriot in the development of wireless telegraphy. Moreover, Branly is sixty-four years old and this was his third candidacy, while Mme. Curie is only forty-three and had never before applied for admission. It is not customary to admit a candidate on the first application, and Mme. Curie's chance of living until the next vacancy shall occur is greater than Branly's.

Who is this remarkable woman who so nearly surmounted these formidable obstacles? The dry and formal account of herself and her work which she submitted with her application, according to custom, is perhaps more eloquent than an exhaustive biography. Marie Sklodowska was born in Warsaw November 7th, 1867. She became a student in the University of Paris where she attained the degrees of licentiate in physics in 1893 and licentiate in mathematics in 1894. In 1896 she received a certificate of fitness for the secondary instruction of girls, and in 1900 became lecturer in physics in the Ecole normale supérieure for girls in Sèvres. In 1903 she received the degree of doctor of physical science, in 1906 she became lecturer in general physics in the University of Paris, and in 1909 she was promoted to the professorship of general physics, as successor to her lately deceased husband, Prof. Pierre Curie, to whom she was married in 1895.



MARIE SKLODOWSKA CURIE

Immortalized by her researches on radium.

She is an honorary or foreign member of the Royal Institution of Great Britain, the London Chemical Society, the American Philosophical Society, the American Chemical Society, the Imperial Academy of Sciences in St. Petersburg, the Royal Swedish Academy and other learned bodies, and has received the honorary title of Doctor from the universities of Geneva and Edinburgh. In 1898 Mme. Curie, then thirty-one years of age, received the Gegner prize from the French Academy of Sciences, nominally for her extensive researches relating to the magnetic properties of iron and steel, although the report of the awarding committee also alludes, in terms of the highest commendation, to the researches in radio-activity which she had already begun, in co-operation with her husband, and to their recent discovery of the radio-active element which Mme. Curie named Polonium, in honor of her native country.

The Gegner prize was awarded to Mme. Curie again in 1900, and a third time in 1902, together with the Berthelot medal. In 1903 the Nobel prize for physical sciences was awarded, half to Mons. and Mme. Curie and half to Henri Becquerel, whose discovery of the spontaneous radio-activity of uranium ore formed the basis of all subsequent researches in radio-activity. Only a few days ago we heard the news that Mme. Curie has been honored with the Nobel prize a second time, on this occasion in the division of chemistry. The list of medals and prizes which have been awarded to Mme. Curie in foreign countries is too long to quote.

In addition to the numerous researches in radio-activity which she made in collaboration with her husband, Mme. Curie has published a great many independent papers, and a volume, "Investigations of Radio-active Substances," in which the results of their co-operative researches, including the epoch-making discovery of radium, are set forth.

Radium and polonium are not the only fruits of this ideal marriage, which was blessed by the birth of two children who already give evidence of inheriting the genius of their parents. After the shocking and untimely death of Pierre Curie, who was killed by a truck on a Paris bridge, in 1906, at the age of fifty-seven, a large majority of his colleagues recommended to the ministry of public instruction the appointment of his widow and coadjutor as his successor. The result is that this gifted woman, the only one of her sex who has ever received this high honor, is now a full professor in the venerable Sorbonne.

All who have seen Mme. Curie at work in her laboratory, or have listened to her lectures, have been impressed by her undemonstrative zeal, her abstraction from external disturbances and her aversion to sensational effects.

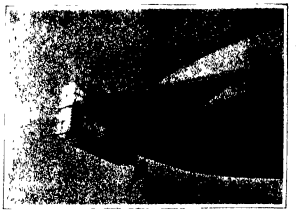
The early life of Marie Sklodowska Curie is less well-known to the general public than the later phase, in which she has become famous. And yet there is a peculiar romantic, and indeed pathetic interest attached to the incidents of her youth. Her father was a distinguished physicist, and professor of chemistry at Warsaw, Poland. Her mother died when the child was yet quite young. Marie grew up in her father's laboratory, imbibing the spirit of scientific research, and acquiring that sureness of eye and skill of hand which is so indispensable to the worker in experimental science. It is no doubt largely to her very early initiation into the technique of laboratory work that her extraordinary ability in this direction must be ascribed. Marie's apprenticeship was, however, brought to a rather early close by the pressure of necessity. As the daughter of an impecunious college professor, the eighteen-year-old girl set out to earn her own living as governess to the daughters of a Russian nobleman. But Providence had destined her for another fate. In one of those agitations which have been so common in the history of Russia, a patriotic society of students at Warsaw was brought under the scrutiny of the ever-suspicious government, and for fear of being compelled to testify against some of her father's pupils, Marie migrated from her home country and took up her abode in Paris. There she lived for a time a life of the utmost privation. Her repeated efforts to obtain employment in one of the laboratories seemed to avail her nothing. Finally she was allowed to perform some of the trivial offices in connection with the preparation of laboratory experiments. And once this meager foothold was gained, it was but a matter of days before the extraordinary faculties of the new assistant had attracted the attention and caused the amazement of the head of the department, Prof. Lippmann. The eminent scientist befriended the girl, and incidentally also introduced her to one of his most promising pupils, Pierre Curie, with whom she became associated in research, and later, in the bonds of wedlock. It was she who fanned to new endeavor the flagging spirits of her husband, in those moments of discouragement which are apt to come to all engaged in intense scientific research. And together they gained the undying trophies of fame when, with the isolation of radium salts the name of Curie suddenly rose to international renown. And then, not many years later fell that terrible blow, separating the two who together had faced the hardships of everyday life, and in strangely perfect union had toiled, against much discouragement to reap the precious harvest of scientific research. While crossing the street Prof. Curie tripped and fell, and was instantly killed by a passing truck. Thus in an evil hour France was bereft of one of her greatest physicists, the world of a genius and Madame Curie of her life companion and husband. Her composure, upon receiving the terrible news, is commented upon by the *Gaulois* "Nothing could have been more characteristic of the wonderful Madame Curie, than the coolness with which she received the news of her bereavement. There were no tears, no traces of grief. Over and over she repeated 'Pierre is dead!'" One feels that here perhaps the Frenchman, with his demonstrative temperament, somewhat misjudges this great woman. The deepest emotions are not always those that can find their vent through the common channels of physical expression. To us there seems something infinitely pathetic in the monotonous repetition of that simple and sad formula, as the mind that with the insight of a genius has successfully grappled with some of the most abstruse problems presented to the science of to-day in the realm of inanimate matter, is brought face to face with the great problem of life and death. Here all men are on a level and impartially fate has dealt to this great genius as to us all life's share of human sorrow. Yet with unbroken spirit, and with renewed devotion she turns to continue now in loneliness, her great life work, her priceless gift to humanity.

One can not help reflecting on the retribution dealt by fate to the Eastern monarchy—that makes life unendurable to the scholar of independent thought—in taking from her the woman who would have added the brightest laurel to Russia's wreath of scientific attainment.

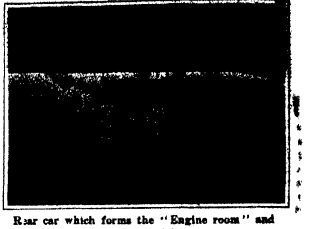
Zeppelin's Schwaben

A High Speed Craft for Passenger Service

By Carl Dienstbach

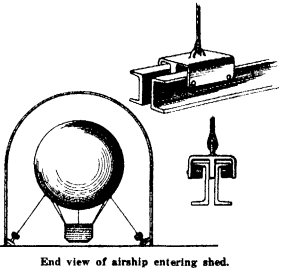


Sharply pointed stern with "tail" and rudders like those of an aeroplane.



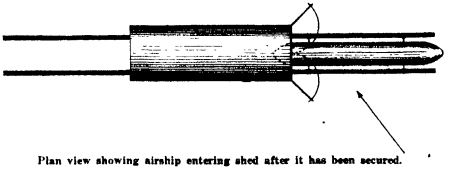
Rear car which forms the "Engine room" and holds two powerful motors.

IT is only recently that the true significance of the great dirigible dockyards in Friedrichshafen became apparent. From the early summer of 1910, till the spring of 1911, no new airship left the stocks, and when finally a second "Deutschland" put in an appearance, she looked like a mere reconstruction, showing neither greater speed nor better maneuvering qualities than the first "Deutschland," which had been shipwrecked the year before. Still there was progress in a less conspicuous but very important direction. The first "Deutschland" had come to grief because under very adverse conditions and with a motor failing at the most critical moment, she could not be kept afloat, and gradually settled into the pine trees covering the crest of the Teutoburger Wald mountains which she had to cross at that time. To strengthen the new "Deutschland's" floating power in any similar emergency, her hull was built lighter, permitting her to carry more ballast for the same number of passengers. In addition a special test was made over Lake Constance, to show the exact amount of the lifting and depressing effect that could be obtained from her propellers and rudders alone. It was found that with only two motors and two propellers in action, the new ship could be raised by power like an aeroplane, from a static level of equilibrium at an elevation of 2,132 feet to 4,756 feet. This represents a purely dynamic lift of considerably more than two tons (4,400 pounds). With three motors and four propellers the ship rose further from 4,756 feet to 5,904 feet, adding nearly another ton (1,980 pounds) of dynamic lift. It remained for some time at this level, carrying four passengers, its regular crew of nine, 242 pounds of fuel and oil, and more than two tons (4,400 pounds) of ballast. If one-half of this ballast had now been shed an elevation of 7,514 feet could have been reached, while still carrying over one ton (2,200 pounds) of ballast. This proves an astonishing reserve of floating power for the arrow-like Zeppelin balloons. If their motors remain intact and they are not overloaded with passengers. What it means in warfare is shown by a simple consideration. In spite of their bulk, they are safe from artillery fire at such high levels. Their diameter is hardly greater than the wing spread of a Wright aeroplane which at the same height appears as a mere speck in the sky, and a Zeppelin at this level look like a match, its lean shape making it a poor target. In the thin air its own speed increases, going with the strong winds of these high levels, even the slow "Deutschland" will easily surpass 60 miles an hour, making her entirely immune. Bomb dropping from aircraft becomes efficient in every respect in exact proportion to the weight of the bomb. A torpedo containing one ton of dynamite dropped from the "Deutschland" from an altitude of 8,000 feet, could be aimed with all the certainty of a shell. Air currents (and air resistance) have so little influence on this great mass that its flight through the air would be determined solely by the speed of the ship over the ground and by its altitude both easily ascertained. Considering that a mere turn of the rudders will instantly deprive the ship of a lift of three tons, it is seen that the sudden dropping of a ton of ballast has no influence whatever on the stability of its flight. It seems odd that to-day the French depend so much on a costly chain of fortresses, which might be very efficient in preventing any repetition of the sudden victorious dash of the Germans in 1870, if the tedious hauling of heavy ordnance and building of entrenched batteries were the only means of reducing them, when in the Zeppelins the Germans now possess an instrument so efficient to bombard the "key fort" without any preparation or risk, and on the sole condition of fairly good and clear weather.

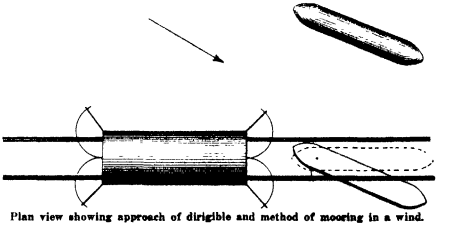


End view of airship entering shed.

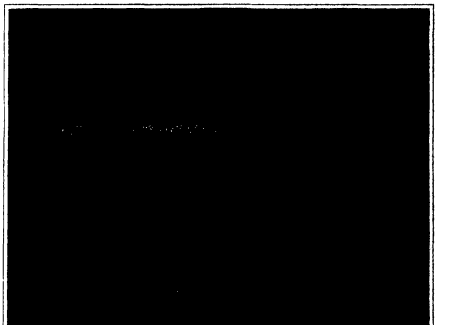
Small drawings show rails and trolleys to which the dirigible is anchored



Plan view showing airship entering shed after it has been secured.



Plan view showing approach of dirigible and method of mooring in a wind.



The "Schwaben" traveling across country at a lively clip. The anchor ropes may be seen at the bow blown back by the wind.

NEW RIGID ZEPPELIN AIRSHIP.

Although the new "Deutschland" had been amply insured against any conditions such as destroyed the first, it was soon to fall a victim to an odd and unforeseen accident—a collision with its own shed. Trivial mishaps from lack of experience unfortunately involve a great loss of money and prestige if they happen to a large and costly dirigible instead of an inexpensive aeroplane. But in this case vindication was not long delayed. The new passenger ship "Schwaben" was almost completed when the "Deutschland" broke in two. It was a little smaller, displacing 634,500 cubic feet, instead of the "Deutschland's" 667,560; 462 feet long instead of 499 for the same beam of 46, and with 17 gas cells instead of 18. In spite of this handicap it showed a speed of a fraction less than 43 miles an hour in the trial trips, measured exactly by running in calm air many times in both directions, over a piece of straight railroad track of known length. As this speed exceeds that of most biplanes, and principally that of the representative Wright aeroplane, it revolutionizes all former ideas about the dirigible and its inferiority to the aeroplane. As a matter of fact the "Schwaben" won in a race with a Euler biplane, from Darmstadt to Frankfurt. With only two of her three motors running, it still broke all previous dirigible records, at 38 miles an hour. The great improvements in Zeppelin's ships, of which the "Schwaben" was the first brilliant exponent, concern first of all the motors. There is nothing on which the safety and success of a rigid airship depend so much as on the reliability and power of its engines. This lesson had been so well learned in Friedrichshafen that the Zeppelin factory finally undertook to design its own motors. Mr. Maybach, one of their engineers, set to work improving the standard Daimler motor, which drove the earlier ships. He increased the number of cylinders from 4 to 6 and the horse-power from 110 to 165. The reliability also was so improved that the "Schwaben's" engines have never given trouble in over a hundred passenger trips, some of which were 700 miles long. Many experiments had also been made to better the shape of the hull. The difference between the "Deutschland's" conical bow and the egg-shaped bow of the "Schwaben" is striking. To diminish friction the outer envelope of the "Schwaben" was stretched very carefully over the frame, so it is so smooth and firm that non-technical observers have compared the "Schwaben's" "solid" hull to that of a warship, on account of its "gray" color. To further cut down head resistance, the three

(Continued on page 484.)

Pumping Gold Bullion from the Sea

Recent Efforts to Salve the "Lutine's" Treasure

DURING the past summer season efforts were renewed to recover more treasure from the wreck of the old British frigate "Lutine." This waterlogged hulk has been a fascinating speculation for a good many years, and the alluring part of the project lies in the fact that no one knows just how much specie and bullion the ship carried when lost. What is known, however, is that something like half a million dollars worth of gold and silver bars and coins have been reclaimed in the course of the past century There is every reason for the belief that the frigate had many times this treasure on board when she sailed from England on the 9th of October, 1799, and this belief has inspired the efforts made from time to time to bring to the surface the buried riches

In the last years of the eighteenth century, plodding Hamburg awoke one morning, so to speak, to find herself the principal commercial port of northern Europe, and this sudden prominence came when she was financially unprepared to meet the exigencies of trade Her bankers were unable to provide the funds for the prompt honoring of bills of lading, and exchange involved a discount of even as much as thirty per cent. Business could not be pushed at this rate without a ruinous loss, and the merchants of London, with the assistance of British bankers determined to relieve the stress by shipping funds to the German port At first, it was intended to send the money in a merchant craft suitably convoyed by an armed ship, but news of this relief movement rapidly spread among the London traders and it was finally decided to dispatch the gold and silver in a man-of-war because of the amount involved It was believed that in this way the menace of the French cruisers could best be avoided and the treasure more speedily and safely delivered in Hamburg Accordingly, Admiral Duncan, then commanding the British North Sea fleet, detailed the frigate "Lutine"—a ship captured from the French some years before—for this service. The "Lutine" was loaded with her precious cargo secretly in order that the enemy across the Channel should not know of her mission This secretiveness has been principally responsible for a large measure of the uncertainty which has since existed in regard to the quantity of bullion and specie dispatched On the 9th of October, 1799, the "Lutine" sailed from Yarmouth Roads and headed north for Hamburg in the teeth of a heavy wind By the time the ship reached the North Sea the wind had grown into a gale blowing directly toward the Dutch coast In the gloom of that fateful night and under the pressure of the wind and the treacherous sweep of the North Sea currents, the "Lutine" struck the Dutch coast near the entrance to the Zuyder Zee It is quite probable that none of her officers knew of her danger She hit the sands at full speed, and immediately was thrown over on her beam's end. At the time, she carried quite three hundred persons aboard, but so sudden was the disaster that but two of this total number survived

The morning after the "Lutine" struck, the ship had substantially disappeared from above water save for the wreckage which littered the beaches of the near-by islands of Terschelling and Vlieland There was no one to tell how the ship happened to be out of her course nor anything as to the extent of her precious cargo At that time, the Dutch government was an ally of France, and claimed the wreck as spoils of war so that it was quite impossible for the British to do anything toward salving the sunken property Without going into the history of the matter, the specie aboard the frigate and most of the gold and silver bars had been insured at Lloyds' of London, and those underwriters promptly paid up A year or two after the "Lutine" went ashore, the King of Holland gave official sanction to salvage operations upon the wreck At that time, the hulk was not embedded in the sand and it was easy to reach it at low tide The work was pursued by guarded fishermen using oyster tongs and other primitive implements However, despite these handicaps, the government recovered treasure to the value of nearly $280,000 The sea did not intend to give up her riches readily, and toward the end of 1801 the wreck was completely buried by a bank of sand, which put an effectual stop to further salvage operations by means of the facilities then available It was not until 1814 that efforts were renewed to recover the remaining treasure, but the undertaking was unsuccessful In 1821, a company, known officially as The Decretal Salvors obtained a royal concession from Holland upon the understanding that fifty per cent of the value of what ever should be salved should be paid to the Dutch government This enterprise was composed of Netherlanders, and is still in existence In 1822, the British underwriters, stirred by the efforts of the Dutch company, appealed through diplomatic channels to the King of Holland The latter, to show his friendly regard for the King of England, donated his interest in the wreck to King George IV, who, in turn, made over this gift to Lloyds' committee as a part indemnification for the loss that Association had suffered in the wrecking of the "Lutine" This point is of present concern because all salvage operations, since 1823, by British subjects, have been authorized by Lloyds' of London and, to that extent, backed by that Association The Decretal Salvors still have their right in fifty per cent of the values recovered

In 1857, the swirling currents at the entrance to the Zuyder Zee swept the hulk clear of sand, and at once salvage operations were renewed diving dress being employed for the first time in the undertaking It was not until the following year, however, that any substantial results were obtained By the middle of October, 1858, gold and silver bars and specie were brought to the surface amounting to a value of $140,000 It did look as though the buried riches were surely to be reclaimed, but the North Sea decided otherwise, and once more hid the hulk under a heavy blanket of sand The Decretal Salvors stuck to the task from year to year with varying results and by the end of 1860 they had to their accumulated credit a total recovery of $220,000 worth of treasure The bulk of this was found around the stern of the wreck and within an area sheltered by the ship's rudder which was still in position The salvors remained passive until 1867, and between that time and 1886, the results were too meager to pay for the labor involved In 1886, steam, suction, shell-dredgers were engaged in the work for the first time It was believed that it would be possible in that way to remove the overlying sand which had increased in depth over the hulk Work in this way was pursued for the next three years yielding various coins to the combined value of $4,600 The shell dredgers were operated each season for the following four years but none of the treasure was brought to the surface The various other efforts made since 1892 and until the National Salvage Association took over the task during the present year have been without result

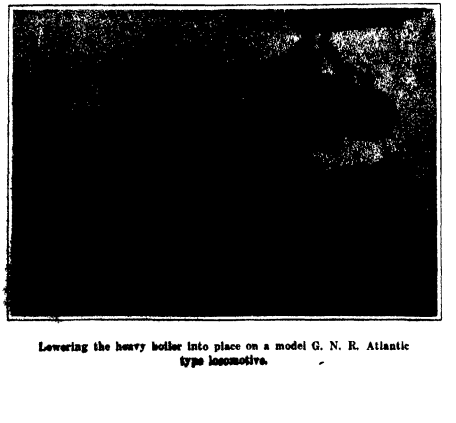
The present salvors have attacked the problem from a new point Heretofore, all of the money and bullion reclaimed has been found lying outside of the contour of the stern of the wreck and on the side upon which the hulk rested The National Salvage Association believe the bulk of the gold and silver to have been stowed amidships in the shot lockers adjacent to the main cable-room—the cannon balls being piled on top of the treasure It is hard to understand what foundation exists for this opinion As the midships section in Fig 2 shows, the cable-room and shot lockers occupy a large space freely open to the crew by reason of the exigencies of service, and it is difficult to justify the placing of such riches in an exposed place of this sort On the other hand the after magazine of those old frigates was a carefully guarded room and either that compartment or one of the divisions lying in the same after section would have been the likeliest place to hold valuables that called for continual surveillance The fact that all of the gold and silver bars and most of the coins so far recovered have been found buried in the sand about the stern bears out the belief that the treasure was housed in the magazine or nearby

Garden Railways

Elaborate Toys and Serviceable Miniatures on English Estates

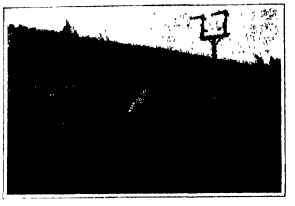
By Percy Collins

GARDEN railways are now quite the vogue in England and their popularity is extending to other countries The diminutive rolling stock and permanent way fall naturally into two groups, viz., those which are too small to be regarded as anything but elaborate toys, and those which possess sufficient power and stability to accommodate passengers and freight. An important event in the history of garden railway engineering was the standardization of gages. Now-a-days model railway work is based upon recognized standards which cannot be altered. There are four small gages, ranging from 1½ inches to 2½ inches, and six large gages ranging from 3½ inches to 15 inches. Models produced by leading firms accommodate themselves to one or other of these gages, while amateur workers, for their own convenience, adhere strictly to the same standards. In each gage a multiplicity of accessories made to scale, such as stations, signal-boxes, bridges and level crossings, are obtainable. The smallest

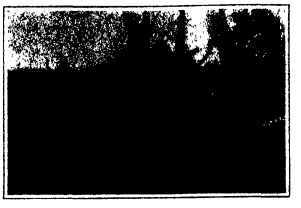


Lowering the heavy boiler into place on a model G. N. R. Atlantic type locomotive.

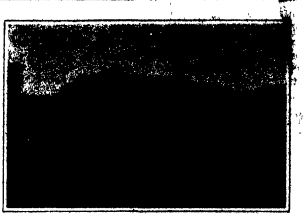
gages of all are specially suitable for indoor work but the 2½ and 2½ inch gages are both popular where outdoor railways are concerned each having its own circle of votaries Several elaborate systems in the latter gage already exist, the most notable being the "Great Holmwood Railway" at Thorp, Norwich, the property of Col J R Harvey, by whose courtesy we are able to reproduce the accompanying photographs A brief description of this system will give the reader an idea of the possibilities for pleasurable occupation which a garden railway offers The main line is a continuous single track, 750 feet long which passes round a loop The permanent way is laid on a brick foundation about three feet from the gravel walk, in order to obviate the necessity for stooping when attending to the models. The curves are all 24 feet radius, and there are gradients of 1 in 40, 1 in 60 and 1 in 70 the remainder of the line being level Including sidings, there are some 600 feet of track the laying of which necessitated the



A 15-inch gage locomotive on the Rhyl miniature railway.



Gasolene locomotive built to resemble a steam locomotive.

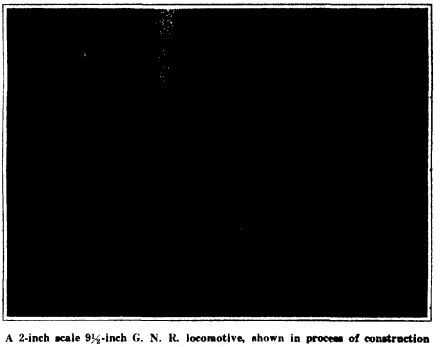


Getting ready for the day's work.

use of 7,200 chairs and 10,800 brass screws There are three through loops, eight sidings, four principal stations, three bridges, two tunnels, an engine-shed and turntable, and seven running sheds, five being 18 feet long and two 8 feet long There are two pits for lifting up one having the rails hinged to drop for convenience in getting at the burners of the locomotives also a tank with distilled water supply, and a complete system of signals, points, and footlights A "third rail" has been laid down over the entire system, so that the whole line is available for electric traction The permanent way was ballasted with "blue billy" obtained from the local gas works—a wise precaution against the growth of weeds All the bridges which span the garden paths are so constructed that they may easily be lifted up The steam locomotives of the "Great Holmwood Railway" comprise a four-wheel coupled outside cylinder bogie tender engine, a four wheel coupled bogie ten wheel tank-engine with outside cylinders, a four wheel coupled inside cylinder tank-engine and a four wheel shunting engine The electric models comprise a tube locomotive fitted with a special design of motor by Messrs Marshall & Wood, a four-wheel coupled tank engine fitted with an Avery motor, and a Great Northern Railway single express engine equipped with a motor in the tender as well as in the engine

The rolling stock includes some forty odd vehicles ranging from a platelayers' trolley to a mail coach and sleeping and dining saloons There are open trucks, closed trucks, crane trucks, tipping contractors' wagons, goods and passenger "brakes," with types of various other vehicles all being fitted with central buffers, which are never found to interlock when the train is passing round curves A speed of eight miles an hour has been attained on a measured length of this railway while the locomotives are capable of pulling with ease a train of thirteen coaches

Another noteworthy railway is the property of Mr G S Mitchell of Sheffield It has a gage of 7¼ inches, while the "inner circle" is laid also with a 3½ inch gage track to accommodate the owner's smaller models. The length of the main line is 439 feet, of the inner line 330 feet, while there is also a connecting line of 62 feet and an engine-shed line of 110 feet Upon leaving the shed, the locomotive passes down a steep gradient into a cutting four feet deep, from which over 100 cartloads of earth were removed It then enters the 54-yard long tunnel, which is the chief engineering feature of the line built, as it is, of brick throughout, on proper drums, with 14 inch side-walls and arch bricks for roof The tunnel is properly drained, and the bank through which it passes consists of about 200 tons of earth The line emerges near "South Junction," the branch for the "inner circle," which passes round an ornamental lake A very perfect system of signalling has been instituted Sixteen signals are in use, and all of them are duly lighted when the line is used after dark There is a properly-equipped signal-box, and by obeying the ordinary laws of signalling and by codes of flag-signals—red and green lamps at night—and engine whistles the safe control of the line may be achieved without the interchange of a word between driver and signalman Mr Mitchell's locomotives comprise a 3½-inch gage tank-engine, a 3½ inch gage Great Northern Railway model, also a



A 2-inch scale 9½-inch G. N. R. locomotive, shown in process of construction on the previous page.

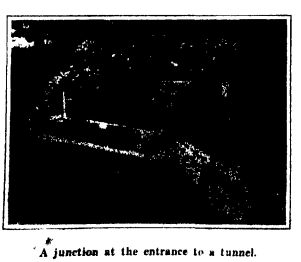
7¼ inch gage "Precursor" locomotive, built from designs by Mr Greenly All the engines are fired with a mixture of three parts coke and one part anthracite coal The rolling-stock includes a large double bogie wagon and a ballast truck, as well as a 3½-inch gage driving truck, with water and coal space, for use with the small locomotives

A few enthusiasts, with the necessary space and cash at their disposal favor the 9½-inch gage, with models made to a scale of 2 inches to the foot, that is, one-sixth full size A photograph showing such an engine undergoing its "works test" is here reproduced. It is a scale model of the Great Northern Railway "Atlantic" locomotive No 1442, which hauls the Royal train When in full working trim, the model—the boiler of which is made of copper throughout, and fired with ordinary coal—weighs 950 pounds. In favorable circumstances it will pull a load of two tons, and travel at a speed of seventeen miles an hour It may interest the reader to know that the cost of such a model, capable of pulling himself and his friends in specially-designed passenger trucks, would be about £300.

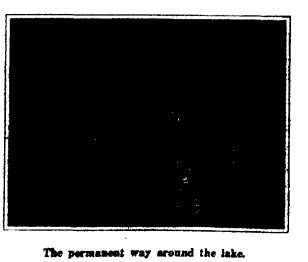
The so-called light railways, with a gage of 15 inches, accommodate models built to a scale of three inches to the foot. When space permits, and when the additional cost is not a barrier, this gage will certainly be found to constitute, in practice, the ideal for a garden railway This was the gage employed by Sir Percival Heywood when he constructed the famous "baby" railway on the Duke of Westminster's estate, at Eaton Hall in Cheshire. Roughly speaking the line cost about $6,500 per mile to construct, exclusive of the various buildings and other paraphernalia. It connects Eaton Hall with Balderton Siding, on the Great Western main line, some four and a half miles distant, and is almost exclusively used for freight, though the rolling-stock includes one passenger coach—an eight-wheeled carriage capable of accommodating sixteen persons—in which visitors to the Hall, including Royalty, occasionally travel The trains on this railway carry, on an average, some 6,000 tons each year, and travel from 4,000 to 5,000 miles

The original locomotive of the Eaton Hall Railway is known as "Katie." Her cost was £400, and she was designed and constructed by Sir Percival Heywood More recently a locomotive of the "Atlantic" type, appropriately called the "Little Giant," was tried on the line This engine was constructed by Messrs Bassett-Lowke, and proved capable of hauling 12 tons on a level at four miles per hour, and five tons at 15 miles per hour up gradients of 1 in 100. With 2½ tons behind it on a falling gradient, it attained the enormous speed of 26½ miles per hour, equal to a scale speed of more than 100 miles per hour In matters of detail, this engine and its duplicates represent the high-water mark of model engineering

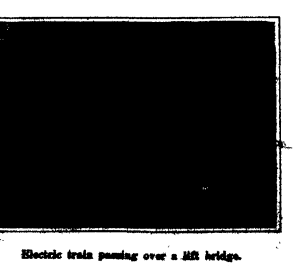
The Eaton Hall Railway is not, of course, required to prove itself financially profitable, but the 15-inch gage is being exploited commercially at the present time. In November, 1904, a limited company, styled the Miniature Railways of Great Britain, was formed to operate tiny passenger systems. The first of these railways was built on the south shore at Blackpool It met with immediate success, and has since been followed by similar railways in Sutton Coldfield Park,



A junction at the entrance to a tunnel.



The permanent way around the lake.



Electric train passing over a lift bridge.

GARDEN RAILWAYS

...Birmingham, the International Exhibition at Turin, in France, and the Shepherd's Bush Exhibition in London. More recently the company has laid down miniature railways in the Zoological Gardens and Park near Halifax, and in the grounds of the International Exhibition at Brussels. Among other notable garden railways is that laid down by the Rev. J. E. Preston in his vicarage garden at Ballantown, Drogheda, Ireland. Mr. Preston has made with his own hands the sleepers, locomotives, carriages, points, and signals. He also prints and issues his own tickets.

The gage of the railway is 1 foot 9 inches, and consists of about five tons of rails, 14 pounds to the yard. Though "miniature," it is large enough to carry its constructor and his friends round the grounds.

Apart from the successes which these miniature railways have scored at pleasure resorts, no reasonable doubt can be entertained that, where land is available, they would prove equally profitable for the conveyance of passengers and goods from railway stations to outlying districts. Permanent way materials, which include steel rails—weighing 12 pounds to the yard—fixed to steel corrugated sleepers by tips and dogs, all necessary fish-plates, bolts, nuts, etc., including bending, and four sets of switches, would cost in the neighborhood of $1,800 per mile. To this must be added the cost of construction which would vary according to the nature of the land over which the railway was laid. The approximate cost of an "Atlantic" type locomotive would be about $1,600.

It remains to be said that the photographs reproduced on these pages give a genuine idea of the power possessed by these diminutive locomotives.

Science

Disastrous Typhoon in Formosa.—Consular reports state that the worst typhoon experienced in Formosa for fifteen years swept over the island on August 31st. In the city of Taihoku, alone, over 2,000 houses were completely wrecked, fifty-eight people were killed outright, and twenty-nine others lost their lives in a railway bridge accident. The sugar-cane crop of the island was injured to the extent of 20 per cent, and the rice crop 15 per cent.

Ventilation as a Protection Against Frost.—To the long list of the means heretofore proposed of protecting fields, orchards and vineyards against frost a new one has recently been added by M. F. Chavernac. Writing in *Progrès agricole et viticole*, he points out the fact that frosts are not feared when the wind blows; he is thus led to suggest the creation of an artificial wind by the installation of electric fans among the plants to be protected. He considers this plan applicable chiefly to vineyards, but also possibly useful in orchards.

Sugar from the Nipa Tree.—According to Dr. H. D. Gibbs, of the Philippine Bureau of Science, the nipa tree—already so useful to the Philippines and the East Indies generally as a source of thatching, matting, cigarette wrappers, toddy, and an edible fruit—promises to revolutionize the sugar industry of the islands, as its sap yields a sugar of superior quality. Samples tested in his laboratory polarized at 98.8 per cent, a gain of 8 per cent over the highest quality now exported from the Philippines. While sugar made from palm trees (of several species) is no novelty, the product has heretofore been unimportant in the world's markets.

Agricultural Education in Korea.—One example of the enlightened policy of the Japanese in dealing with their new possession, Korea (now officially called Chosen), is seen in the great progress of agricultural education in that country. Since 1906 the authorities have established thirteen agricultural schools and fifteen model experimental farms, the oldest and most important being the station at Suwon (Suigen), which is excellently equipped and managed, and compares favorably with some of the best institutions of this character in the United States. From this school there are 98 graduates who have taken the full three years' course, while 37 students have taken special shorter courses.

A Spanish Polar Expedition.—Several recent occurrences in Spain have betokened an awakening, in that country, of interest in scientific matters. Accordingly we are not surprised to hear that the Spaniards are planning an arctic expedition. The project was submitted to a recent meeting of the Royal Geographic Society of Madrid by F. J. Gisbert, who has had some experience in polar exploration, and a committee has been appointed to raise the necessary funds, which it is estimated will amount to $125,000. Senor Gisbert proposes to drift for three years in a trans-polar current—à la Nansen—starting from a point north of the Alaska coast, in 160 deg. west longitude, whence he expects to reach the Greenland Sea. Side trips are to made on sleds, in order that exploration may cover a zone of 100 miles on either side of the ship's position.

The City of Dairen, formerly called Dalny, is said to be the most up-to-date town in Manchuria. Here the Japanese are spending large sums annually on street, sewer and lighting improvements. Good hotels are maintained by the South Manchuria Railway (which is a semi-official organization). This line now runs express trains four times a week to connect with the trains of the Siberian Railway; they are unsurpassed in the Far East, being equipped with Pullman coaches, dining cars, and sleepers. The railway also operates a twice-a-week steamer service to Shanghai. The wharves of Dairen are said to be the finest in the Far East, vessels drawing up to 28 feet being moored alongside the quay. The port is open the year round, as the ice that forms in the bay is never thick enough to interfere with navigation. During the year 1910 1,389 steamers entered this port with cargo, and 457 in ballast, their tonnage aggregating 1,697,710.

Electricity

Wireless Telegraphy in the South Seas.—Wellington, New Zealand, will soon have one of the most powerful wireless telegraph stations in the world, with a radius of action of 1,000 miles. The government of New Zealand also intends to establish medium-power stations at the Chatham islands, a small group 600 miles southeast of Wellington, and at Raratonga, in the Cook group. As the latter will be able to communicate with Tonga, New Zealand will be within reach of Fiji.

Fender Chains for Panama Canal Locks.—In order to protect the gates of the Panama Canal locks, heavy chains are to be stretched across the lock chambers to receive the impact of vessels which get beyond control. These chains will be raised and lowered into grooves in the masonry by means of hydraulic mechanism. The hydraulic system will be controlled by solenoid valves, which will admit the water pressure to the cylinders. By using valves of this character, the chains may be controlled electrically from any desired central point.

Motor Trucks Need No Rest.—In a paper read before the Electric Vehicle Association of America, Mr. Hayden Eames called attention to the fact that horse-drawn vehicles must remain idle for a certain portion of the day in order to rest the horses. A recent investigation showed that the teams of the different express companies in New York city were idle forty per cent of the total working hours, much of this idleness being due to the fact that the horses needed rest, and that the periods of loading the wagons had to be suited to these rest hours. The motor vehicle on the other hand requires no rest, and hence requires no adjustment of the loading hours.

Electrically-cured Meat.—Some time ago we described in these columns an electrical method of curing hams, which was discovered by a Cincinnati packer. He found that by introducing an alternating current through the pickling brine the hams could be cured in from 30 to 35 days, as against 90 to 100 of the ordinary method. A large plant in Cleveland, Ohio, is now curing meat by this process. Ten 5,000-pound vats are in service. The current is furnished by a 100-kilowatt generating plant. The plant generates direct current for use in various capacities, and a portion of it is converted into alternating current by means of a rotary converter, to provide the energy used in the curing vats.

Resistance of Silicon at Various Temperatures.—Writing in the *Physical Review*, A. A. Somerville points to the fact that the resistance of the majority of metals increases steadily with the temperature up to their melting point, at which point there is a very sudden rise in resistance. Silicon, however, acts very differently. From zero to 350 deg. Cent. the resistance decreases gradually, and above this point, up to 500 degrees, it increases, reaching a value nearly equal to that of ordinary temperatures. Above 500 degrees the resistance rapidly decreases again. This curious phenomenon was observed in a large number of tests, showing that the result was not due to any peculiarity in a particular specimen, but was a property common to silicon.

Electrically-driven Road Roller.—A contractor in Independence, Kan., has had an electric road roller constructed for his use. The road roller is driven by a 10-horse-power motor, which obtains its energy through a flexible cable, 160 feet in length, connected to a transformer mounted on wheels. This in turn is connected with the supply system of the neighborhood, obtaining current at a voltage of 2,300 and slipping it down to 220 for use in the motor of the road roller. These flexible cables give the road roller sufficient radius of action for ordinary purposes, but when it is necessary to operate at a considerable distance from the only available transmission line, a temporary power transmission line is constructed very quickly. The cost of operating this roller in connection with the laying of brick pavements has been $6 per block. This amount covers the process of rolling the ground before and after the bed of crushed rock has been applied to it, and then rolling the brick after it has been laid upon the rock bed. The motor-driven roller weighs altogether 15,000 pounds.

Aeronautics

A Powerful Two-motor Monoplane.—Some months ago, in competition for the Gould-Scientific American prize, the Queen Aeroplane Co. produced a twin-motor monoplane fitted with two 50-horse-power Gnome motors. Piloted by Arthur Stone, this machine flew at Nassau Boulevard, but came to grief at the first turn. Short Bros., in England, recently built a two-motor biplane having the same equipment as the monoplane just mentioned, but it remained for a French engineer, M. Legrand, to bring out a biplane racer with two 100-horse-power Gnome motors. This machine was flown successfully by Camille Guillaume at Juvisy on October 20th last. The Coanda biplane which participated in the military contest recently also had two motors and a bevel gear drive to the propellers.

Rodgers Has a Bad Fall in California.—Transcontinental aviator C. P. Rodgers, after a week's rest at Pasadena, attempted to fly the remaining 25 miles of his journey on the 12th inst., and to land at Long Beach. He had gone but a few miles when he was forced to alight at Cobina Junction because of engine trouble. After making temporary repairs he flew on again as far as Compton, where, in making a forced descent, he fell 100 feet sustaining concussion of the brain, severely sprained ankles and internal injuries. Rodgers' mind was a blank for thirty hours. He has since explained his fall as a result of sheer nausea which overcame him when flying at a height of 1,000 feet. He attempted to descend, but when 100 feet from the ground became unconscious and lost control of the machine.

Test of Vaniman's Airship "Akron."—After a considerable delay, the first test flight of the "Akron" took place at Atlantic City on November 4th. Manned by her full crew of five, the airship maneuvered for more than an hour above the inlet at Atlantic City. A strong breeze arose, and the airship was progressing against it splendidly when Vaniman fell across the rubber hose connecting the motor with the radiator and broke it. Knowing that the motor was about to stop, Vaniman steered his vessel down head on into the shallow water covering a mud flat. Not until the tide rose were the motor boats able to rescue the disabled airship. A 70-mile gale on the 12th inst. damaged the "Akron's" shed but the craft itself was not injured. Vaniman has given up the idea of making the trip this year.

Recent Aeronautic Fatalities.—By a strange coincidence of fate a parachute-jumper a celebrated balloonist, and a well-known aviator met their deaths within a few days in widely diversified ways. When he cut loose from his balloon 2,000 feet in the air at Guthrie, Okla., on November 10th Samuel Heller's trapeze bar broke. He managed to hang on until within 200 feet of the earth, when he fell and was killed. Edgar W. Mix, the American electrical engineer and balloonist, who won the Bennett Cup race in 1909, committed suicide by jumping overboard from a channel steamer on the 12th inst. Herr Pietschker, a well-known German pilot of the "Albatross" biplane, fell to his death at Johannisthal, near Berlin, on November 15th. His neck was broken.

Robinson's Flight Down the Mississippi.—After a week's delay owing to stormy weather, Hugh Robinson, with his Curtiss hydro-aeroplane, ascended from the surface of Lake Calhoun at Minneapolis on the 17th ult., and started on his proposed flight to New Orleans. With the wind behind him, he flew 110 miles to Winona, Minn. in 1 28, or at the rate of 88 miles an hour, where he landed in the Mississippi river. In landing he struck a snag and damaged his hydroplane float. On October 19th he covered 91 miles in 83 minutes—an average speed of 65¾ miles an hour. His flight down the river was terminated at Rock Island, Ill., the next day, as the different cities which had given him guarantees withdrew them when they found he would probably make the flight without. He set a new record in that he carried mail for over 300 miles and collected and dropped off letters at the various towns at which he stopped. His flight is the longest ever accomplished with a hydro-aeroplane.

Abstracts from Current Periodicals

Phases of Science as Other Editors See Them

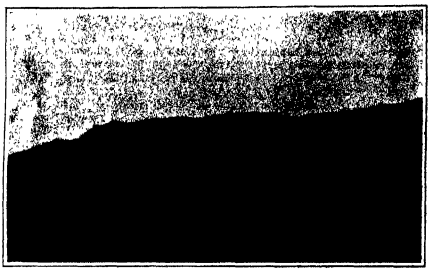
Floods Caused by Over-grazing

AMONG the recent publications issued by the Forest Service is Bulletin 91 entitled "Grazing and Floods, A Study of Conditions in the Manti National Forest, Utah," by Robert V R Reynolds, Forest Examiner This bulletin consists of a recital of the triumphs of strict protection of the cattle and sheep range on a typical region subject to floods and erosion The facts brought out in this publication plainly show that the absence of floods in the Manti National Forest can be attributed only to the protection afforded by the excellent crop of forage on the area closed to grazing

"The Manti National Forest in central Utah has for a number of years been subject to severe floods after all storms of more than usual violence, with corresponding scarcity of water during periods of drought A careful study made during the spring and summer of 1910 showed clearly that this condition of erratic run off had followed heavy overgrazing in the mountains, and that where grazing had been restricted the conditions were rapidly improving The problem of securing an equable streamflow is a vital one to the towns located along the base of the Wasatch Range These are not only dependent upon the streams for their water supply, but they have also suffered heavily from floods in the past and are still constantly in danger" Again "In 1910 a committee composed of two sheepmen, two cattlemen, and a merchant, representing the towns of Orangeville and Castledale and surrounding agricultural settlements in Emery County expressed the belief that floods are due mainly to the denuded condition of the range which has resulted from over-grazing, and requested the protection of these watersheds In support of their request they stated that for many years after the settlement of Castle Valley in 1878, floods were unknown Soon after the ranges on the heads of the streams were heavily stocked with sheep and cattle, however, freshets began to occur with each heavy rain during the summer months, and these have steadily increased in volume and destructiveness"

Mr Reynolds contrasts the former conditions of grazing distinctive in most of its aspects, with the well regulated methods now generally in vogue on all the principal water sheds where the government still holds title to the land The period of strict grazing supervision is one of the most remarkable epochs in the history of forestry and conservation

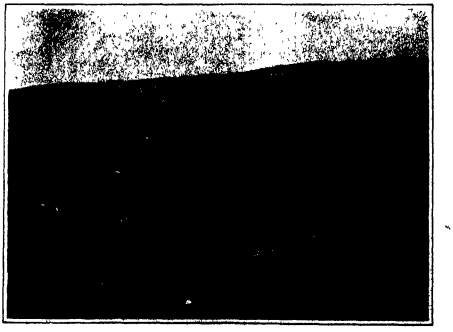
Until one examines the entire ground carefully it is impossible to see why the Forest Service annually comes to Congress as a solicitant of favors It has the right to demand support This support it does not always have because its work in some parts of the West often runs counter to organized sheep and cattle men Formerly it was the fashion in the West to ridicule the work of the Forest Service as being largely theoretical, and perhaps a part of the earlier work was that came for the humorist in that day but that day is past and great results are being accomplished One is obliged to admit that the triumphs of the Forest Service have been many and that a large part of its success is due to the original work of the ambitious young men who have entered the service during the last ten years and whose painstaking endeavors are beginning to bear fruit



The effect of erosion as a result of over-grazing.



A large band of sheep in corral.



Boulders carried down by floods brought on by over-grazing the higher land.

The Earning Power of Chemistry

IN a public lecture to business men delivered recently under the auspices of the Indiana Section of the American Chemical Society Mr Arthur D Little claims for chemistry that it is the most fundamental and likewise the most comprehensive of all the sciences

Among the practical applications of chemical research, Mr Little mentions the work done by Brown and Mrs. Richard in the laboratory of the Massachusetts Institute of Technology, "work which has been the means of saving countless lives throughout the world and has led to such understanding and made possible such control of sources of pollution as to almost justify the statement that for every case of typhoid fever some one should be hanged"

Mr Little assures us that chemistry can now determine in advance the suitability of a given water supply for use in boilers or for the requirements of any special line of industry, as paper-making, dyeing, cloth finishing, brewing and so on.

"Chemistry pervades the packing industry, reducing the cost of food by utilization of by-products of the most varied character, from oleomargarine to glycerine and soap and from soap to pepsin and adrenalin

"Carbon disulphide made in the Taylor electric furnace has preserved the wine industry of France by destroying the phylloxera, as it is ridding our own fields of prairie dogs and our elevators of rats and mice. Bread-making and brewing are coming each year more and more within the recognized domain of chemistry, which is at the same time greatly enhancing the value of our staple crop by the increasing production of glucose, corn oil and gluten. Exactly one hundred years ago Kirchhoff discovered the inversion of starch to glucose by dilute acids. To-day the United States alone is richer by $20,000,000 a year by reason of that discovery."

Among other instances of the commercial utilization of chemistry Mr. Little mentions increased crop yields by proper fertilization, increased profits by utilization of the cotton seed for oil, cattle feed, adaptation of the short fiber adhering to the ginned cotton seed hull to the making of smokeless powder and the stalks of the cotton plant to paper-making.

There are also to be considered wool degreasing processes which convert wool grease into oleic acid, soap, lubricating oils and potash and ammonia salts; the carbonization of cotton fabrics; the wonderful processes whereby coal tar is made to yield perfumes, dyes, aseptics, explosives, photographic developers and a host of other substances; the modern development of artificial silk from cellulose, the manufacture of artificial horsehair and of artificial bristles composed of cellulose acetate; the production of illuminating gas; the introduction of the modern gas mantle of the Welsbach type; the chemical research which has resulted in improving the incandescent lamp, so that in the last ten years there has resulted a saving of twenty-four million dollars a year in the cost of lighting, as compared with the cost of equal illumination by the older types of lamp; the analysis of flue gases, so as to save fuel

Mr Little concludes with a quotation from Prof Robert Kennedy Duncan

"During the next five years the small manufacturer who is swept out of existence will often wonder why He will ascribe it to the economy of large scale operations, or business intrigues or what not, never knowing that his disaster was due to the application of pure science that the trust organizations and large manufacturers are already beginning to appreciate"

Eye Color and Mental Traits

IN reviewing in *Science* the third edition of Punnet's little classic "Mendelism," W. E Castle cites the following interesting passage:

"A discussion of eye color suggests reflections of another kind. It is difficult to believe that the markedly different states of pigmentation which occur in the same species are not associated with deep-seated chemical differences influencing the character and bent of the individual. May not these differences in pigmentation be coupled with and so become in some measure a guide to mental and temperamental characteristics? In the National Portrait Gallery in London the pictures of celebrated men and women are largely grouped according to the vocations in which they have succeeded. The observant will probably have noticed that there is a tendency for a given type of eye color to predominate in some of the larger groups. It is rare to find anything but a blue among the soldiers and sailors, while among the actors, preachers and orators the dark eye is predominant, although for the population as a whole it is far scarcer than the light. The facts are suggestive, and it is not impossible that research may reveal an intimate connection between peculiarities of pigmentation and of mind.

Weather "Kiosks" at Home and Abroad

Meteorology for the "Man in the Street"

By C. Fitzhugh Talman

THE conservative behavior of Weather Bureau thermometers during the heated term has always been viewed with a certain degree of dissatisfaction by the non-scientific portion of the American public. After a particularly torrid day in an environment of brick and mortar, asphalt and steaming humanity, the wilted citizen, whose sensations have registered a temperature of 100 or more, feels aggrieved at a newspaper weather report recording an official maximum of 85. His only consolation was, until recently, the thermometer at the corner drug-store. This imposing-looking instrument usually soared nearly or quite high enough to confirm his personal estimate of the day's weather; especially if it happened to be hung in such a position as to bask in unobstructed sunshine during a part of the day. Some of these drug-store thermometers are fearfully and wonderfully made. As adjuncts of a quasi-scientific branch of trade they enjoy a certain prestige—along with the charts, also affected by drug-stores, in which the professional long-range weather prophet outlines the meteorological conditions for a month in advance on the basis of the moon's phases, the configuration of the planets, or the maxima and minima of sun-spots.



Fig. 1.—German weather kiosks in the making.

At meteorological observatories the instruments are exposed in such a manner as to register, as nearly as the general surroundings will admit, the natural rather than the artificial weather. If, as in the case of most stations of the national Weather Bureau, the location happens to be the heart of a city or town, the ideal, not wholly attainable, is to record the conditions that would prevail if the buildings and pavements were not there. The abnormal weather of a city street is of no importance in gaging the weather of the country at large, either with a view to compiling climatic statistics or to providing information of current conditions for the use of the scientific forecaster. On the other hand, the demand of the "man in the street" for an accurate record of the conditions prevailing in his own little sphere is natural and legitimate; and the official weather service has recently responded thereto by establishing "kiosks."

The first Weather Bureau kiosks were erected in the year 1908, and they have now become familiar landmarks in most of our largest towns. The name "kiosk" officially applied to them is convenient, rather than appropriate. Their architecture is severely classical, and therefore as remote as possible from that of the oriental structures to which this name properly belongs.

Meteorological instruments installed in little pavilions on the public streets are familiar to every one who has traveled in continental Europe. In German speaking countries these structures are called *Wetter-säulen* ("weather-columns"), as they have a somewhat columnar form. In French they appear to have no generic name, but the writer is aware of one case in France—viz., at Le Mans—in which an installation of this general character has been called a "kiosque météorologique" for the past twenty five years, although its appearance is not in the least oriental. No English name for these structures existed—probably because the thing itself was unknown in English speaking countries—until the Weather Bureau decided to install such arrangements in this country. The catalogues of several foreign instrument makers were examined with a view to finding the most suitable form of construction. Here the name "kiosk" was encountered as applied to one of these edifices that happened to have some semblance of oriental architecture. *Faute de mieux* this name was adopted by the bureau, although an entirely different style of construction was decided upon.

The external appearance of the Weather Bureau kiosk, which was designed in America, is shown in Fig. 2. The structure, which is of cast iron, painted a light color, is square, and the instruments are installed on the north side so as to be sheltered as much as possible from the direct sunshine. The other three sides are used for posting weather maps and bulletins and other literature of general interest pertaining to the weather and climate of the locality. The location chosen is the busy center of a town, either a public park or the pavement of a principal street.

Air is freely admitted through gratings at the top and base to the roomy interior, and into this central space project the bulbs of the thermometers and the other actuating parts of the instruments, which are thus screened from the radiation of surrounding objects. The set includes a hair hygrometer, with a scale of percentages of relative humidity, a plain mercurial thermometer of large size, graduated on the stem in conspicuous figures, self-registering maximum and minimum thermometers, the indexes of which are set by a magnet, a tipping-bucket rain-gage, the receiver of which is placed on the roof of the kiosk, while the dial, recording hundredths of an inch of rainfall, is exposed to view in the north panel, and a thermograph, making a continuous record of the temperature on a band of paper providing for a two weeks' registration. Printed labels briefly describing the several instruments render their use clear to the non-scientific public. The instruments are kept in order, the record-sheets changed when necessary, the

(Continued on page 48.)



Fig. 2.—Weather Bureau kiosk.

A miniature meteorological observatory for the "man in the street."



Fig. 3.—A well-constructed German kiosk.

Steady ventilation is provided by a revolving fan.



Photo, by Dr. C. Kassner.

Fig. 4.—"Uraniasaulen" in Berlin.

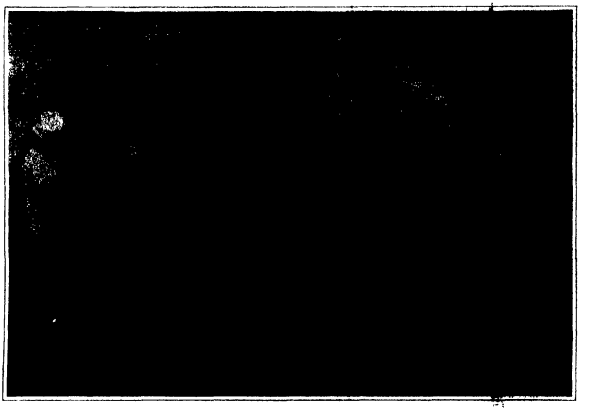
A Landsman's Log Aboard the Battleship "North Dakota"—IV

By J. Bernard Walker.

This landsman's Log is written by the Editor of the SCIENTIFIC AMERICAN *as a preliminary to a magazine Naval Number to appear December 9th, which will be comparable in its size and completeness with the Naval Number issued during the Spanish War. In one respect it will be unique, for it will contain a signed message from President Taft, and will be written entirely by prominent officers of the Navy, each a specialist in the particular field that he covers. The leading article, moreover, will be from the pen of the Hon. George von L. Meyer, the Secretary of the Navy. The illustrations will consist of special photographs taken during the recent maneuvers and target practice of the Atlantic Fleet on the Southern Drill Grounds.*

THE landsman's log will fail of its purpose if it leaves an impression that target and battle practice with guns big and small constituted the whole of the activities of the Atlantic fleet on the Southern Drill Grounds. Nor must it be supposed that the gunnery consisted exclusively of firing by individual ships against individual targets. Every probable variation of war conditions was reproduced. I have a vivid recollection of the particular day when a division of four ships left the fleet steamed in column until they were hull down, then turned, simultaneously, four points to starboard, and, moving at high speed in *echelon*, or diagonal, formation, delivered their broadsides upon a single target 9,000 to 12,000 yards distant. This maneuver, seen, as I saw it, on a glorious September afternoon, was a most stirring and picturesque naval spectacle—with fifty square miles of the sapphire blue ocean for a stage and ten thousand men on a three-mile line of battleships for audience. Two or three points off the starboard bow of the 'North Dakota,' and some four miles distant, was the target, which was being towed at ten knots on the same course that we were following. Abreast of us and five hundred yards to port was the 'New Hampshire," flagship of the Second Division; and, ship beyond ship, I could see the other eleven battleships steaming abreast, each like the 'North Dakota," crowded on its bridges and forecastle deck with eager spectators of the attack. The firing division, six miles distant from the target, was some seven miles off the port bow; the farther end of our line. And so, from the observing fleet we watched the four ships manœuver now firing at the extreme bearing, for the whole broadside, forward, then turning to bring the batteries to the extreme bearing aft—and throughout it all at the target, there soared majestically skyward those snow-white columns of water that told of the accuracy or otherwise of the shooting.

On other days individual ships would attack two widely separated targets at once—and again, ships would be sent out at night to try their 12-inch batteries upon targets that were 9,000 yards distant; while throughout all these operations the corps of wireless operators were working out special problems relating to their own special work, and particularly with respect to "interference."

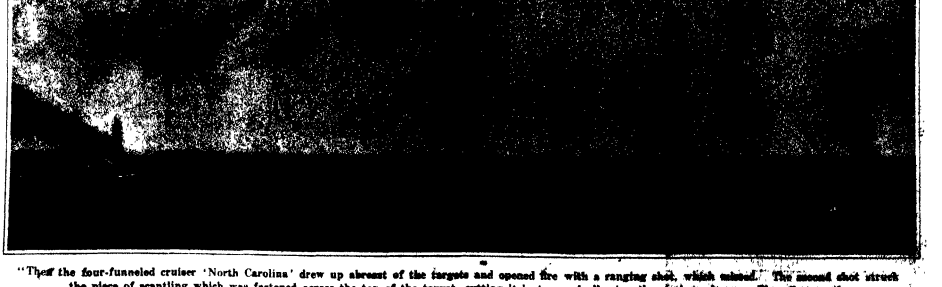


"Aerial gun practice, however, is not confined to one-pounders and three-pounders. The Springfield rifle, whose bullet, at 45 degrees elevation of the gun, reaches a height of 6,800 feet, is such an effective piece that it will afford no inconsiderable defense against any aeroplane that might attempt to execute feats of bomb-dropping."

Every era of naval history has been fruitful, in varying degrees, in novel inventions and improvements and the many new problems which they have inevitably introduced. High explosives, electrically-operated mines, smokeless powder, the rapid-fire, high-velocity gun, the automobile torpedo, the torpedo boat, the destroyer, and the submarine have each in turn exercised their powerful influence upon the design and maneuvering of ships. To-day there has appeared a new engine of warfare, more puzzling than any of its predecessors, because, unlike them, its operations are not confined to the sea, but have invaded an entirely new element—the air.

Although the attitude of the Navy Department toward the so-called "aeroplane warfare" is conservative, it is by no means reactionary. While it is realised that much of the speculation as to the offensive capabilities of the aeroplane is premature and not justified by the present state of its development, naval men concur in the belief that, when a suitable type of machine has been evolved, the aeroplane will play an important part in the strategy of the future. This conviction has been deepened as the result of the experiments carried out by Ely and Curtiss in the effort to produce a machine suitable for naval scouting. The Curtiss "Triad," as it has been called, has shown that it can start and alight from a calm sea, and the work of this remarkable machine, following the feat of the late lamented Ely in alighting on the deck of a warship and starting therefrom, which has been repeated on other occasions, has carried the aeroplane scout a long step forward toward the stage—still a long way distant—when it can be regarded as a "perfectly" reliable medium for naval scouting. The exigencies of naval warfare demand that the aerial scout shall be capable of starting on its mission and gathering and transmitting its observations *in any weather*. With the present form of pontoons this is impossible, and it is difficult to imagine any form of sustaining device that would carry an aeroplane over the waves of a rough sea at the speed which is necessary for flight. It is possible that the solution of the difficulty will be found in the construction of special aeroplane tenders—high-speed vessels, with long, unobstructed reaches of deck, suitable as starting and landing places for the machines. Such vessels, if they were provided with large rudder area and designed for unusually quick maneuvering and rapid changes of speed, should be accessible for the safe return and landing of aeroplanes, even in considerable stress of weather.

But to return to our log, which, if it is to be true to its name, must contain a record, not of theories and



"Then the four-funneled cruiser 'North Carolina' drew up abreast of the targets and opened fire with a ranging shot, which missed. The second shot struck the piece of scantling which was fastened across the top of the target, cutting it in two and allowing the cloth to droop. The effect on the firing was instantaneous; for the range being now known, the gunners put shot after shot through the targets."

opinions, but of the actual work of the Atlantic fleet on the Southern Drill Grounds, as seen by civilian guests, and of the impressions which it has left upon the civilian mind.

One of the most instructive and novel of the many visits paid to other ships of the fleet was an early morning trip to the "Michigan" for the purpose of witnessing aerial target practice. On mounting the gangway we found that the quarter deck had been turned into a veritable kite factory. Yards of red bunting, reels of wire, and a plentiful supply of light pine scantling was in the process of being built up into a number of box kites and several square targets measuring each about twelve by fifteen feet.

Now the handiness of the sailorman is proverbial; but I never knew till I got aboard the "Michigan" that he was an expert kite builder, and since I am perfectly certain that the building of box kites is not to be found in the curriculum at Annapolis, I may be pardoned my surprise and appreciation at seeing a stalwart lieutenant, armed with hammer, pliers, and a bag of wire nails, knocking a box kite together with as much facility as he would handle a sextant or a range finder, plot his ship's course, or bring a 20,000-ton battleship to her moorings.

The box kites completed, they were flown in a group of three from the stern of the "Michigan;" and after much hauling and slacking, and, or shall we say "backing and filling," were coaxed out of the bewildering cross currents of air, which formed the aerial wake of the ship, into the light and steady breeze which was blowing. The end of the cotton rope to which the kites were attached was made fast to a steel wire, which led through a haul down block up to an extemporized winding drum, at the head of the port gangway to the boat deck. As the wire was paid out, the targets were attached to it in the position shown in our engraving, and when they had been lifted to a height of some 300 feet above the water (the limit of the lifting power of the kites in the light air which was blowing) they were ready for the firing.

Two ships had been delegated to the work of destroying the enemy; and as soon as the targets were ready one of the "Connecticut" class of battleships steamed rapidly out from the fleet until she was abreast of the targets and about 2,000 yards distant therefrom. She opened fire with her starboard battery of 8-inch, 14-pounders, fired some two or three dozen rounds, and then steamed in at full speed to take a closer look at the targets and see how often she had winged the enemy. Not a single shot had found the mark! Then the four funneled cruiser "North Carolina" drew up abreast of the target and opened fire with a ranging shot which missed. The second shot struck the piece of scantling which was fastened across the top of the target, cutting it in two and allowing the cloth to droop in the center. The effect on the firing was instantaneous, for, the range being now known, the gunners put shot after shot through the squares, making a total of about a dozen hits. The different results accomplished by the two ships showed clearly the need for some form of tracer, such as I described in the last section of the log, dealing with night firing, to show the the course of the shells through the air and enable the sight-setter to make the proper corrections on the sight bars.

During the progress of the firing, the ordnance engineer of the "Michigan," who had charge of the kite flying, drew my attention to a phenomenon, which he suggested would form an interesting subject of speculation for the readers of the SCIENTIFIC AMERICAN. He asked me to note that after a 12-inch gun was fired, two distinct reports of the discharge were noticeable—one a sharp characteristic snap, which seemed to come from the locality of the target, and the other a more muffled report which reached the ship a few seconds later. The sharper report, by my timing, reached the "Michigan" in about 2½ seconds' time, the second report in about 5½ seconds' time. Now the velocity of the shell when it leaves the muzzle is about 2,800 feet per second; the velocity of sound is about 1,140 feet per second. The distance from the gun to the "Michigan" and the target (which was about 300 yards astern of the "Michigan") was about 6,000 feet, so that the sharp report traveled to the ship at the velocity of the shell and the duller, muffled report at the velocity of sound.

Now here is a pretty little problem in acoustics which we present for consideration. How came it that the first report of the gun reached the ear in about half the time that it should have taken, by all the laws of acoustics, in making the journey? Some one on the ship suggested that the first report was due to the noise of the shell as it passed the ship. But the "scream" of a shell is continuous, rising to its maximum intensity as it passes the listener, and dying away as the distance increases. Another suggestion was that a part of the sharp sound wave of explosion traveled in the attenuated air immediately behind the shell, being, in fact, "paced" by the shell, and that this portion of the air wave was sufficient to produce the loud, snappy effect above referred to.

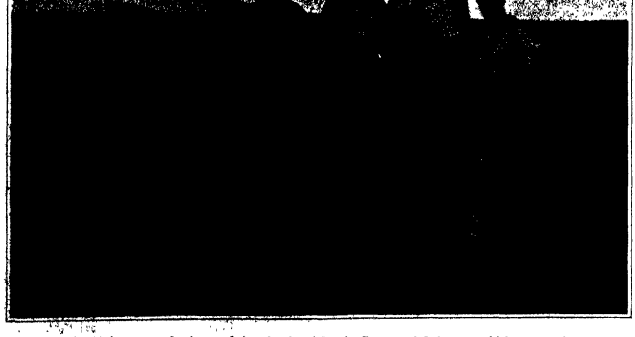
The ordinary gun mount on board ship allows of an elevation not much above 15 degrees. For successful defense against aeroplanes, a higher elevation is necessary, and an experimental one-pounder is now being developed by the Bureau of Ordnance which, at an elevation of 45 degrees, will throw its shell to a height of 9,000 feet and a maximum range of 6,100 yards. With 85 degrees of elevation the shell will reach a maximum height of 18,000 feet.

Aerial gun practice, however is not confined to one-pounders and three pounders. The Springfield rifle, whose bullet reaches a maximum height of 6,800 feet, is such an effective piece that it will afford no inconsiderable defence against any aeroplane that might attempt to execute those feats of "bomb dropping" which are so popular a subject in the pages of the magazines and the Sunday papers. This rifle fires a 0.30 bullet with a muzzle velocity of 2,700 feet per second. Held at an angle of elevation of 45 degrees, the bullet will reach a maximum height of 6,800 feet and travel to a maximum range of 5,500 yards.

(To be continued.)



"The ordinary gun mount on board ship allows an elevation not much above 15 degrees. For successful defense against aeroplanes, a higher elevation is necessary."



"An experimental one-pounder is now being developed by the Bureau of Ordnance, which at an elevation of 45 degrees will throw its shell to a height of 9,000 feet; and with 85 degrees of elevation will reach a maximum height of 18,000 feet."

The Demand for Young Men in Electrical Engineering

By Dugald C. Jackson, of the Massachusetts Institute of Technology

ANY branch of engineering is an exacting mistress for the man who makes it his profession, and this is particularly true of electrical engineering, which demands from its followers an unusual breadth and variety of industrial knowledge because it enters into the processes of almost all of the great industries found in the nation. The scope of an electrical engineer's work may be indicated by many striking examples. Both of the world's means of quick intercommunication, the telegraph and telephone, use electrical processes and those of the telephone are so complex that they demand in their management a high class of engineering skill. City, suburban and interurban traction systems have fallen almost entirely under the monopoly of the electric motor, and railway freight traction over mountain divisions of steam railroads seems likely to soon come under the same influence. The electrical transmission and distribution of power have put artificial illumination of streets and houses on a plane never previously reached or imagined, and their processes are being constantly improved and extended. Even in the manufacturing industries, the use of electrical power has served to increase the output and decrease the cost of product in many different kinds of works, and the utilization of electric power is therefore greatly enlarging.

It is obvious that adequate training for a profession that brings its followers into contact with so many of the activities and nearly all of the industries of the nation must consist essentially of those principles of science and humanity which are fundamental to all, and an electrical engineering course must therefore be made strong in chemistry, physics, mathematics and applied mechanics, and those subjects must be associated with the study of machinery, stationary structures, hydraulics and steam engineering. Also along with these, extended study is required of the fundamental nature of the flow of electric current, the phenomena of electromagnetism, and the ways in which these may be usefully applied in the world's activities and particularly in industrial affairs. Very little time can be given to those features of engineering practice which are of a nature which can be mastered with comparative readiness by observation after graduation. An appropriate electrical engineering course sufficiently occupies the time available for undergraduate study if it is confined to cultivating a knowledge of scientific and eco-

(Continued on page 482)

The Inventor's Department

Simple Patent Law; Patent Office News; Inventions New and Interesting

A New Process for the Felling of Trees

By Dr. Alfred Gradenwitz

THE attempts from time to time to cut trees with a wire heated by electricity so far have not given satisfactory results

Now a Berlin inventor, Mr Hugo Gantke has recently succeeded in designing an extremely simple device for the mechanical felling of trees The trunks are cut by the fraction of an ordinary steel wire about one millimeter in diameter (No 18 B & S gage) which, as shown by practical tests, is able to saw through a tree about 20 inches in diameter, in six minutes

The steel-wire, driven by an electric motor, is heated so intensely by friction on the wood as to burn a thin carbonized kerf, which is both smoother and cleaner than the cut of a saw The charcoal layer adhering to the trunk is extremely thin and allows the structure and any disease of the wood to be distinctly recognized It enables the tree to be marked with chalk, and at the same time serves to preserve any trunks that may be left temporarily in the woods

Unlike other saws, this felling machine will work freely even on the thickest trees, without requiring any wedges to be inserted into the cut, for instead of any shavings we have only smoke and steam and hence there is no danger of the cut's becoming obstructed The trees may be cut close to the ground, or even below the ground as far down as the beginning of the roots will permit In the latter case the stump may be safely left in the soil The electric motor that drives the steel wire is placed where it is not in danger of being struck when the tree falls

While mechanical operation is in itself much more rapid than hand-labor, a further acceleration is derived from the absence of any intervals of rest between two cuts As a new piece of steel wire costing but a few cents is taken for each cut, there is no loss of time due to the sharpening of saws, etc Only one man is required to operate the machine as against two men working with hand saws, and the larger the tree the higher is the relative cutting speed

When electricity is not immediately available, it can be generated by any existing steam or water plant It may frequently be found advantageous to use a portable power-plant consisting of a 10 horse-power gasoline motor and dynamo which may be installed temporarily in a central location A flexible cable may connect the dynamo with the felling machine which can be readily transported and operated by one man

An important advantage of the new method arises from the absence of any waste, the cut only two millimeters (0.079 inch) in thickness being perfectly smooth and level, while rear axes and saws are bound to injure the trees to a considerable extent

Review of the Report of the Commissioner of Patents

THE Commissioner of Patents, Hon Edward B Moore, in his report to the Secretary of the Interior, for the fiscal year ending June 30th 1911 makes some very vigorous recommendations regarding needed legislation for the United States Patent Office, besides touching upon the work already accomplished along the line of improvement in that branch of the service

The Commissioner reports the work of the Office to be in a very satisfactory condition and practically up-to-date in all its branches. He states that while Congress has been fairly liberal in its appropriations for the increase of salaries and providing new positions, thereby enabling the institution of many needed reforms, there is still a certain percentage of separations from the Office of trained examiners who accept offers of larger salaries from outside firms and corporations. The Commissioner, however, does not ask for an increase in the salaries of the examining corps at this time.

Gains in Efficiency and Economy.

The Commissioner reports that a saving of from five to six thousand dollars annually has been the result of the change in the manner of printing certificates of trade-mark registration, and that this saving will be continuous annually The changes in the rules of practice relating to trade-marks, which were effective November 1st, 1911 are expected to accomplish a considerable saving of time to examiners in searching this enormous class of applications At the present time it is required that the examiners search through some 20,000 pending applications, which are in the various stages of prosecution It is proposed to have the same rules apply to applications for the registration of trade-marks as now apply to applications for patents, that is, they must be amended within one year or the application becomes abandoned, the applicants still having the right to file new applications if desired

Plans are under way to accomplish an economy in the method of publishing and issuing the *Official Gazette*, to the extent of saving between eighty and ninety thousand dollars a year This will, it is believed, increase the efficiency of the *Gazette* as a work of reference, reducing its bulkiness and making it more compact and easily handled

Legislation.

The Commissioner renews his recommendations with regard to the urgent legislative needs of his Office Paramount is the bill recently reintroduced by Mr. Oldfield, the Chairman of the House Committee on Patents, which provides for the elimination of one of the appeals within the Patent Office This measure contemplates the consolidation of the board of examiners-in-chief with the Commissioner and the two assistant commissioners, forming one judicial tribunal to hear appeals taken from the primary examiner. It is argued by the Commissioner that this will accomplish an immense saving in time for the passage of appeals through the Patent Office and will also be a saving in money to the inventor, who will thus be relieved of the necessity for paying for a double appeal in the Patent Office in carrying his cases through to the Court of Appeals of the District of Columbia, the court of last resort in such cases.

The policy of the Government at the present time is to avoid all unnecessary duplication of work and relieve the officers of the various branches of much work that has become burdensome to all concerned, as well as wholly unnecessary. Mr. Moore states that it is practically the unanimous opinion of inventors and manufacturers throughout the country that one appeal should be eliminated in the Patent Office in order to save the great cost and loss of time now involved in obtaining a final adjudication and consequent grant of patent

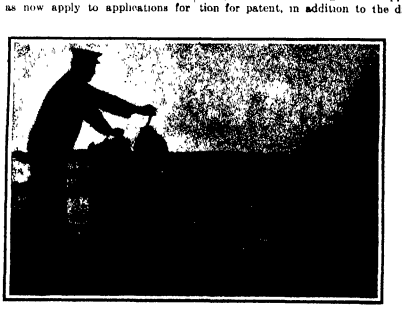
He further states that he has been supported widely in this effort to facilitate business, and states that this is an important part of the plan to expedite business and to grant patents to inventors within a reasonable time, which they have demanded, and to which they are entitled. Bills embracing the substance of this recommendation were introduced by Senator Smoot and were passed by the Senate. No action, however, was taken upon these bills in the House.

Other measures of importance are strongly advocated by the Commissioner One provides for the filing with an application for patent, in addition to the drawing, two photographic copies of such drawing This imposes upon every applicant for patent an additional statutory requirement, to wit, to file with each application of which a signed and attested drawing forms part, two photographic copies of such signed and attested drawing. The purposes of this requirement are to guard against and enable the detection of unauthorized changes in the original drawing or abstraction of such drawing and substitution of another; and to lessen the danger of serious mistakes on the part of the Office in failing to detect interferences between co-pending applications for the same invention.

An important measure is that which requires that an application for patent shall be prosecuted within six months after any action by the Patent Office. The bill is aimed to cause the more speedy prosecution of applications and should have the effect of preventing the holding of applications within the Office for a great length of time for the purpose of extending the patent period.

The Commissioner also urges the passage of the bill which authorizes the issuance of certificates of correction in cases where the patent as printed does not conform to the record.

In connection with the recommendation for elimination of one of the appeals in the Patent Office, the Commissioner furnishes a table showing the extent of the heavy appeal docket for the fiscal year, which epitomized, shows the number of interferences declared to be 1,537; appeals to the examiners-in-chief, 1,102; appeals and petitions to the Commissioner, 2,912.



Portable device for mechanical felling of trees.

The Heany Cases.

The Commissioner reports the termination within the Office of the investigation arising out of the original criminal trial of Heany, Barton and Everding, for forgery and violations of Sections 5408 and 5440 of the Revised Statutes. The criminal trial, which resulted in the conviction of Barton and Everding and the acquittal of Heany, was followed by the Commissioner's order against Heany to show cause why certain interferences in which his applications were involved, should not be dissolved and his applications included therein and other applications also tainted with fraud should not be stricken from the files and treated as a nullity. The hearings resulting from this order were before the First Assistant Commissioner, owing to Mr. Moore's being occupied with other important duties connected with the conference at Buenos Aires and the conference at Washington. The hearings began in the summer of 1910 and lasted for several months.

The conclusions reached, ordering that the Heany applications be stricken from the files, as set forth in the First Assistant Commissioner's decision printed in the *Official Gazette* of October 21th, 1911, meet with the Commissioner's unqualified approval, and Mr. Moore also takes occasion to express his appreciation of the valuable assistance rendered by former Examiner-in-Chief L. H. Campbell, Mr. F. C. Skinner, at present Examiner-in-Chief, and by Mr. Eugene D. Sewall, Examiner of Classification, who acted as a Board in the original investigations preceding the criminal trial; and of the services rendered by Mr. Skinner and Jesse C Adkins, Esq., at the trial, and by Mr Adkins and Chief Law Examiner Webster S. Ruckman, during the investigations arising out of the order to show cause.

Mr. Moore states that the Department of the Interior and the Patent Office are to be congratulated at the very satisfactory termination of the criminal case and the Office investigations as well. He reiterates his statement made in a previous report and to the press that the Heany case is the only one of its kind that has ever occured in the Patent Office during the 117 years of its history.

The Patent Bar.

The Commissioner invites attention to the necessity for legislation which would result in the establishment of a patent bar. It is strongly urged that a law be enacted which will provide that before an individual shall be permitted to practice before the Patent Office, he be required to pass an examination as to his moral, legal and technical qualifications, and that a committee be appointed by the Commissioner of Patents composed of officials in the Patent Office and patent attorneys of well-known standing in the profession, who shall conduct the examination under the Commissioner's supervision, the report of such committee to be subject to his approval.

The Commissioner states that a redraft of a measure looking to this reform will with the Secretary's approval, be prepared and presented to Congress in a short time.

Scientific Library and Other Matters.

A complete reorganization of the Scientific Library is contemplated by the Commissioner, who states that a classification of the enormous amount of foreign publications, including patents and works of reference, and books of great value to attorneys and examiners in their search for anticipations in the arts, is an immediate necessity. The Commissioner is desirous of having the whole subject

thoroughly digested, so that it will be readily accessible and thereby do away with much expense and loss of time.

The Commissioner asks for an additional force to aid in this work, and also requests an increase in the force of translators.

International Conferences and Treaties.

The Fourth International Conference of American States held in Buenos Aires in 1910, and the Conference of Washington of the International Union for the Protection of Industrial Property, 1911, are both referred to by Mr. Moore as being productive of much good in the harmonizing of international relations with regard to patents, trade-marks and copyrights. The three conventions adopted at Buenos Aires were prepared by Mr. Moore and are strictly in the interest of the manufacturers, inventors and authors of the United States. These three conventions have all been approved by the United States Senate and are awaiting ratification by the twenty Latin American nations represented, several of whom, it is understood, have ratified them, and others still have them under consideration.

The conference at Washington to amend and consider the Paris Convention of 1883, was attended by delegates from forty nations, including nations adherent to the Paris Treaty and those specially invited to participate, but who had no voting powers. Important conventions affecting changes in both the patent and trade-mark laws were discussed at the conference, and the final convention was adopted and signed by the delegates subject to the ratification of their various governments. The language of the conference was French as provided by the Treaty of Paris.

Mr. Moore, who was chairman of the American delegation, states that it was the announced opinion of all the delegates present that it was the most successful conference of the Union ever held. He states that aside from the very desirable changes of the laws of nations relating to patents and trade-marks, there is another important underlying reason why these conferences are desirable. They bring together men familiar with the subjects to be discussed, who become well acquainted and talk over their differences not only in formal session, but in private conversation, while mingling socially.

During the conference the Commissioner received a cablegram announcing the passage by the German Reichstag of a law upholding the treaty between Germany and the United States, providing that patents of American inventors should not be revoked by the German government for failure to work or manufacture the same in Germany within four years, provided, however, the same is manufactured in the United States in the same period of time. Mr. Moore personally negotiated this treaty with Germany and in addition succeeded in accomplishing the revision of the laws of Norway, Sweden, and Switzerland, so that the manufacture of patented inventions in those countries by United States citizens is not longer required in order to sustain their patents. It is thought that several other countries will speedily follow this example.

Urgent Need for New Quarters for the Patent Office.

As a climax to his other very strong and well-considered recommendations, the Commissioner reiterates with renewed emphasis the very imminent need of new quarters for the United States Patent Office. He offers in his report two remedies for the over-crowded and wholly inadequate conditions that now exists. The first is a complete remodeling of the present building in accordance with plans which he has drawn up and which have been approved by the Supervising Architect of the Treasury and the Architect of the Capitol. The second is the construction of a new building on the site immediately north of the library of Congress, and which was contemplated by the Daniels bill, introduced in the 61st Congress.

The Commissioner urges many excellent reasons in support of his contention, not the least of which is the constant danger from destruction by fire which threatens the valuable archives of the Patent Office, and the loss of which would work irreparable damage to the commercial interests of this country. Considering the fact that there is a net surplus in the United States Treasury earned by the Patent Office and paid in by the inventors amounting to more than seven millions of dollars, the Commissioner believes it only fair that part, if not all, of this sum should be expended in the furnishing of larger and better quarters, with modern facilities for the force, which would then be in a position to accomplish the best possible results in the work for which the outside inventive public pays the total cost.

This is a matter in which the whole country is interested and it should be the avowed determination of every manufacturer, merchant and inventor in the United States to aid in every way possible, within his power, the building of a newer, greater and safer Patent Office.

Death of Examiner McKee

ROBERT M. McKEE, an assistant examiner in the United States Patent Office, died at his home in Washington on November 5th. Mr. McKee was the oldest examiner on the force, being in his eighteth year. He was a native of Hanover, Chautauqua County, New York, served in the Army of the Potomac during the civil War, and gained an enviable reputation as a teacher in the Washington public schools, being up to 1876 supervising principal of one of the prominent school districts. In 1885 he entered the Patent Office as an assistant examiner and for many years examined pneumatic and other door checks and hinges. While nearly eighty years of age, he did not seem an old man, having a bright, alert manner, a clear active intellect, and the appearance of being ten years under his real age. He was able to perform his duties in a most satisfactory manner up to his last illness of nearly three months. He was genial, kindly, possessed the ability to make and keep friends, was skillful in his business, and able to do a man's work to the end and will be greatly missed by the many who had business in his special classes of invention.

Notes for Inventors

Electric Lamp as a Bed Warmer.—John Alden of Boise, Idaho, has patented (No. 1,004,956) a bed warmer which includes a metal casing covered with asbestos so that it will not burn the feet of the sleeper and having an opening through which the heat from an electric lamp in the casing can escape to heat the bed.

Imitation Air Voyage.—In a patent (No. 1,005,961) Robert Macfarlane Murie of Invercargill, New Zealand, provides an apparatus for producing the illusion of traveling in an airship. The apparatus includes a dark room, a lift to support the passengers which is caused to move up, down and sideways in the dark room. A screen is arranged in front of the passengers and moving pictures are projected on the screen, the moving picture device and the lift being connected together so they will move in unison to heighten the illusion.

Combined Aeroplane and Parachute.—William A. Crawford-Frost of Baltimore, Md., has patented (No. 1,005,609) an airship improvement in which a supporting plane is provided with openings and a parachute folds upon the top of the plane to close the openings and opens upwardly to extended position to operate as a parachute when desired.

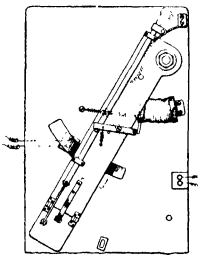
A Concrete Floor With Glass Blocks.—Henri L. J. Crochet, assignor, of Paris, France, has patented (No. 1,005,611) a readily removable paving block for reinforced concrete floors, which is of glass, and has an external thread and is formed in its inner end with a light recess which is adapted to receive a spanner so that the block can be conveniently turned when it is desired to remove it.

RECENTLY PATENTED INVENTIONS.

These columns are open to all patentees. The notices are inserted by special arrangement with the inventors. Terms on application to the Advertising Department of the SCIENTIFIC AMERICAN.

Electrical Devices.

AUTOMATIC SWITCH.—JOHN L. POLK, Memphis, Albany Co., N. Y. This automatic switch is for use in controlling electric currents, the switch in one of its movements being automatic, and also sluggish in its action. More particularly stated a switch is provided having a lever movable by hand in one direction and movable in the opposite direction by the action of a spring and against the cushioning pressure of a dash pot for the purpose of retarding the movement or rendering it sluggish, the idea being that when the switch lever is in one of its extreme positions it closes one electric circuit and a few moments afterward opens that circuit and automatically closes another. A plan view is shown herewith complete, the lever occupying its extreme position to the left and closing one of the circuits.

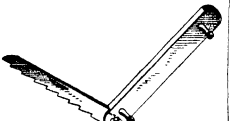


AUTOMATIC SWITCH

COLLAPSIBLE HANDLE CAN.—E. G. CASERA, Portico Vittorio Emanuele, 44, Genoa, Italy. This invention relates to metallic vessels and cans, the object being to produce an article at cheap price and easily carried by minimizing the space occupied in packing. These results are obtained by forming the mouthpiece for pouring the liquid contained in the vessel in the shell of the same and further by providing a yielding handle which, in packing, can be brought in contact with the body of the can, thus avoiding any projecting part.

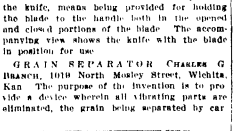
Of Interest to Farmers.

FOLDING HAY KNIFE.—LUTHER L. CARR, Chalmers, Ind. The object in this improvement is to provide a novel construction of knife in which the blade can be conveniently folded into the handle so that when the knife is not in actual use the blade will be housed within and protected by the handle, the handle and the blade being so formed that the former operates as a stop to limit the opening movement of the blade at the proper point and the handle being provided with hand holds for convenience in manipulating the knife, means being provided for holding the blade to the handle both in the opened and closed portions of the blade. The accompanying view shows the knife with the blade in position for use.



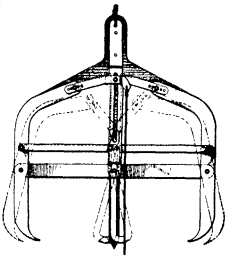
FOLDING HAY KNIFE.

GRAIN SEPARATOR.—CHARLES G. HEARCH, 1010 North Mosley Street, Wichita, Kan. The purpose of the invention is to provide a device wherein all vibrating parts are eliminated, the grain being separated by carriers and the like, thus dispensing with noise, and eliminating the great strain on the mechanism of vibrating or reciprocating parts. A vertical longitudinal section is shown in the engraving. The toothed wheels are very necessary since they thoroughly beat and shake up the straw so that the grain drops out of the straw. Screens and wheels work to secure cleaning action, thoroughly separating grain and straw, so that only a small portion of grain is passed out through the stack.



GRAIN SEPARATOR.

BALE CARRIER.—EDWARD H. BOEHME, R. F. D. No. 2, Rankin, Ill. A front presentation of a bale carrier patented by Mr. Boehme illustrates this article, and the inventor's object is to provide a simple inexpensive and easily operated fork especially designed and adapted for lifting material, such as hay, straw, and the like, in bales, which will firmly hold during elevation and transportation a plurality of bales, and which may be easily and quickly engaged with and released from the bales. The levers cannot be disengaged until the trip rope is pulled.



BALE CARRIER

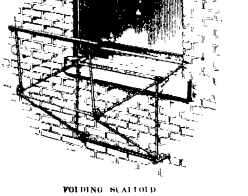
Of General Interest.

HOD STAND.—SAMUEL H. MOORE, Phoenix, Ariz. This invention is an improvement in hod stands for use in holding hods for carrying brick or mortar, and the invention has for an object the provision of a novel construction of folding hod stand which can be adjusted to suit any size of mortar or brick hod and hold such hod when applied to the stand at any desired angle. In practice the stand may be made of wrought iron of suitable size and dimensions to give the necessary strength for supporting the hod and the device will be found useful for the purpose for which it is designed. The engraving shows a perspective view of the stand as in use, the hod being in position.



HOD STAND

FOLDING SCAFFOLD.—F. ZAHN, Rhodesia Park, Norwalk, Conn. Mr. Zahn's invention relates to folding scaffolds for general use, his more particular purpose being to provide a simple, strong and efficient scaffold suitable upon the exterior faces of building walls and



FOLDING SCAFFOLD

adapted to be let out and drawn through windows or the like In order to erect the scaffold a shown in the accompanying illustration the device is let out through the window, so that the window bar lodges against the inner face of the wall upon opposite sides of the window To take the platform within the building the floor consisting of boards (shown in dotted lines) is first removed and taken inside the bar at the top is next grasped and pulled over practically through the window

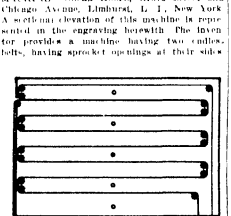
Household Utilities.

MEAT COOKER A Reubold, 1120 Fox Street Bronx New York, N Y This invention provides an airtight receptacle in which food meat is placed, and means for closing this receptacle so that juices and volatile parts of the meat will be retained, thereby preserving the flavor preventing shrinkage and increasing its value as an article of food, the use for which the device is best adapted being the cooking of bone hams and pork shoulders, so as to preserve their flavor, juices and aroma

Machines and Mechanical Devices.

VALVE—I D Robertson, 210 South Seeley Street Chicago, Ill In this case the valve head is of thimble form and fits over and is secured to a cylindrical stem filled with buoyant material, as cork, to float the valve in water The valve is movably confined and guided in a cage and means provide to limit the drop of the valve from its seat It is especially designed for tanks to prevent overflow of water, without interfering with the circulation of air and steam the valve obviously rising and being forced tight to its seat by the rise of the liquid level

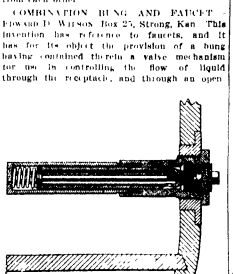
BLUE PRINT WASHING AND DRYING MACHINE.—Oscar Hoops, Grove Street and Chicago Avenue, Elmhurst, L I, New York A sectional elevation of this machine is represented in the engraving herewith The invention provides a machine having two endless belts, having sprocket openings at their sides



BLUE PRINT WASHING AND DRYING MACHINE.

which are disposed against each other, and which run over rollers with sprocket teeth journaled in a casing containing tanks and a compartment for respectively washing and drying the blue prints The prints are conveyed between the belts through the machine, and are introduced and removed at points outside the casing where the belts are spaced from each other

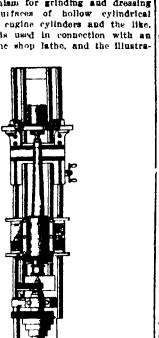
COMBINATION BUNG AND FAUCET—Howard D Wilson, Box 25, Strong, Kan This invention has reference to faucets, and it has for its object the provision of a bung having combined therein a valve mechanism for use in controlling the flow of liquid through the receptacle, and through an open



COMBINATION BUNG AND FAUCET

ing in the side of which the bung is disposed, so that when the plug is removed from the bung the valve is in position for use The accompanying illustration gives a view in sectional elevation showing the device attached to the side of a barrel The bung is made in two sections, so that the valve member may be readily disposed in position.

CYLINDER GRINDING MACHINE.—Edmond Stone and William Stone, 3510 South Wood Street, Chicago, Ill This invention relates to mechanism for grinding and dressing the interior surfaces of hollow cylindrical bodies, such as engine cylinders and the like. The invention is used in connection with an ordinary machine shop lathe, and the illustra-

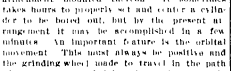


CYLINDER GRINDING MACHINE

tion shows a plan of the lathe having the attachment mounted thereon It sometimes takes hours to properly set and center a cylinder to be bored out, but by the present arrangement it may be accomplished in a few minutes An important feature is the orbital movement This noted always be positive and the grinding wheel made to travel in the path of a true circle and doing the work accurately with all mechanical precision

Railways and Their Accessories.

CROSS TIE—William E Jones, Chase Mills, N Y The object here is to provide a durable cross tie intended to replace the ordinary wooden tie now generally used, which can be employed with railroad track rails and the like, with which ordinary rail-holding means such as spikes, chairs and braces now

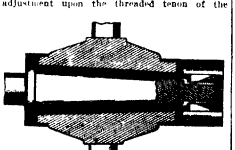


CROSS TIE.

generally employed can be used, which tends to prevent spreading of the rails, by means of which one on the other of the rails can be raised or lowered as necessary, which can be employed on straight track sections as well as on curves, and the employment of which permits the tracks to be easily and expeditiously laid and repaired The engraving herewith gives a plan view which shows the tie used to support a pair of track rails.

Pertaining to Vehicles.

HUB ATTACHING DEVICE—Jefferson D Robertson, La Plata, Md This improvement is in hub attaching devices for use on vehicle wheels and the like and has for an object to provide a novel construction by which the went on the ends of the box fitted upon the spindle may be easily taken up and by which the nut may be adjusted to take up this wear and may be locked in any described adjustment upon the threaded tenon of the



HUB ATTACHING DEVICE.

spindle and in which the locking devices for the nut may be released by moving the same longitudinally in the direction of the axis of the spindle There is a locking ball for the hub securing nut which ball has a cross bar extending radially across the outer end of the nut in position to be grasped in pulling the ball to unlock the nut The engraving shows a sectional view of the device as in use.

Note—Copies of any of these patents will be furnished by the Scientific American for ten cents each Please state the name of the patentee title of the invention, and date of this paper

NEW BOOKS, ETC.

Historical Atlas. By William Shepherd. New York. Henry Holt & Co., 1911. 8vo.; 216 maps, 94 pages of text. Price, $2.50.

This is one of the most valuable atlases that has come to the reviewer's table in a very long time In the first place, the data for the maps have been compiled in a most scholarly way by an expert, also with the advice and assistance of a splendid list of geographers and historians In the second place, the maps, which, by the way, were printed in Germany, are magnificent examples of the cartographer's art The combination of colors which are apt to be so very crude in atlases of American origin are toned down and admirably contrasted It is very difficult to call attention to any salient feature of this book, as it is of uniform excellence. Among the very interesting maps, however, are those showing the various Routes of the Crusaders, the Ecclesiastical Maps of Europe; the very interesting map showing the routes of the Mediaval Commerce; the Seats of the Medieval universities; the Medieval Commerce of Asia; Plan of a Medieval manor; the Age of Discovery, the Principal Seats of War in Europe in all Centuries, the Growth of Russia; Napoleon's Campaigns, the Unification of Germany, the Balkan Peninsula, the Commonwealth of Australia, the Partition of Africa, the Distribution of the Principal European Languages; the Colonies, Dependencies, and Trade Routes, Localities in Western Europe Connected with American History, Localities in England Connected with American History; the Indians in the United States; the New England Colonies, Campaigns in the American Revolution, Territorial Expansion of the United States, Organization of Territories; Slavery and Emancipation in the United States, Westward Development of the United States, and lastly, the Panama Canal It would indeed be ungracious to offer any criticism of this splendid work, but it is suggested that the 208th map, showing the seat of the Civil War, might have been made a two-page map to greater advantage, as a map of this kind is very much needed

To Mother. By Marjorie Benton Cooke. Chicago Forbes & Co., 1911. Price, 50 cents

It is seldom that one can whole-heartedly indorse present day poetry such as this The mother-theme, too, must be well handled not to be made ridiculous by distortion of values on the one hand, or by a cheap verbosity unsuited to meter on the other This being so, we take the greater pleasure in acknowledging the sweet dignity and the repressed yet strong appeal of the author's lines Even in ending her sonnets with the rhyming couplet—a form now frowned upon—we believe she has selected the mode most effective with such a theme and treatment For all mothers, and for all children of mothers, this little gift book must strike a true and uplifting chord.

The Hindu-Arabic Numerals By David Eugene Smith and Louis Charles Karpinski Boston Ginn & Co, 1911 8vo, 160 pp Price, $1 25.

Of all the numerous published monographs on our subject, none can be said to present a complete history of their origin, adoption, and adaptation The libraries of Europe and America have been searched in pursuit of the information embodied in "The Hindu Arabic Numerals," and all available evidence has been carefully weighed and passed upon The result is a reliable and fairly comprehensive review of the subject, from what is known of the origin of the characters, the earlier use of the place value, and the introduction of the zero, to the development of the system by the Arabs and its spread over the face of Europe When we consider that this system has been in general use for not four centuries, and when we realize the amazing clumsiness of the Roman characters which it displaced, we must approach its history with an enhanced respect and with an increased gratitude for what the system has done for our civilization

Text-Book of Mechanics By Louis A. Martin, Jr Vol III Mechanics of Materials New York John Wiley & Sons, 1911 12mo, 229 pp. Price, $1.50 net.

The author gives us a text-book of mechanics, designed for colleges and technical schools, in four volumes. "Statics" and "Kinematics and Kinetics" have preceded this, while "Applied Mechanics" is in preparation. The aim of the series is such an arrangement and presentation of its subjects as will encourage the student to reason as well as to memorise—to prove for himself, instead of simply accepting statements and solutions. The various stresses and strains are classified and explained in this third volume, and diagrammatic sketches and notations lead naturally up to the appended exercises and examples. The answers to the interpolated problems are given together at the back of the book, and there are between forty and fifty review problems given with the object of refreshing the memory and fixing principles indelibly in the mind.



Kindly keep your queries on separate sheets of paper when corresponding about such matters as patents, subscriptions, books, etc. This will greatly facilitate answering your questions, as in many cases they have to be referred to experts. The full name and address should be given on every sheet. No attention will be paid to unsigned queries. Full hints to correspondents are printed from time to time and will be mailed on request.

(12565) L. G. asks: Kindly inform me if rocks, stones, and boulders grow as they lie and are in the earth A. Rocks such as boulders do not increase in size as they lie upon the earth or buried in it. Layers of rocks have formed from their materials being pressed together under the ground by the weight of the earth above them in the long ages of the past.

(12566) A. G. asks: I am ashamed to ask you, but can you tell me the speed at which air at 60 degrees and 15 pounds would rush into a perfect vacuum? I cannot find the information in two encyclopedias nor two books on physics. A. You need not be ashamed to ask at what velocity air will rush into a vacuum, since no one can answer it. Air at 15 pounds pressure rushing into a place where there is no pressure will at that instant have an infinite velocity, the ratio of 15 to 0 From that instant the velocity will diminish until the pressure inside is equal to that outside, and the velocity will then become zero Between these two velocities there will be all possible velocities. No single velocity can be given. The 60 degrees does not affect the result If any text-book or encyclopedia will give a single velocity for this case, it would have to be marked "interesting, if true"

(12567) C A. P asks: Please answer the following in your column for queries: Does the top of a wagon wheel travel faster than the bottom? Please give explanation. A. The top of a wagon wheel travels along the road with the same speed as the wagon to which it is attached, else it would come off the wagon and go into the ditch. All parts of the wheel also rotate around the axle with the same speed, else the wheel would break into pieces. Lastly, the motion of a wheel may be referred to the ground even while it moves. It will then be found to have a very complex motion Mark a spot on the felloe with a chalk mark, so that you can see just where it goes with reference to the ground. As the wheel rolls along, the chalk mark coming down to the ground, is in contact with a point on the ground for an instant, and rises again till it is at the top of the wheel, and this it does every time the wheel moves as far as its own circumference When the mark is half way down from the top it is in front of the hub, and when it is half way up again it is behind the hub It has gone back the whole diameter of the wheel, just as it went up the whole diameter of the wheel It moves down and up, forward and backward, as it rolls around its hub, and moves along with the wagon as a whole The fact is, if the wheel does not slip, the mark stands still on the ground while it is in contact with the ground The fact also is that the mark at the top of the wheel moves forward twice as fast as the hub moves The mark moves backward, as seen from the wagon, from the time it is on the level of the hub moving down till it is on the level of the hub going up, and forward during the rest of its rotation. If you would see the actual path of a point in the circumference of a rolling wheel, take a circular piece of board and fasten a crayon into a hole at the edge; then roll the board along the chalk trough on a school blackboard in such a way that the crayon may trace its path on the blackboard. You will have the curve described by the point of the wheel along a vertical surface, just as the wheel traced its curve in the air. This curve is called in mathematics a cycloid. You will doubtless find a picture of it in any large dictionary. This matter seems to make a great deal of discussion We are obliged to print the explanation very frequently.

(12568) J S K asks: I am curious to know why, if the secondary terminals of a transformer are open, there is no apparent flow of current in the primary windings. For instance, take a bell-ringing transformer designed to work on 110-volt alternating current at 60 cycles and to step the current down to 6 volts. If the secondary terminals were open we detected no current flowing through the primary, but when the secondary was closed our instrument showed a flow of current in the primary. If you can give me the reason for this in the columns of your paper I will be under obligations to you. A. When the secondary circuit of a static transformer is open it is perfectly idle, no current is flowing through it, and no inductance exists between the primary and the secondary. In this case the primary acts simply as a choke coil, and the inductance of the primary upon itself cuts the current in the primary down to a small value. In your little bell-ringing transformer it is too small for your instrument to detect.

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PATENTS

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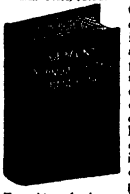
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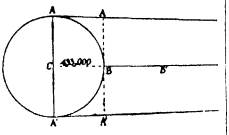
If the Sun Were Suddenly Extinguished

To the Editor of SCIENTIFIC AMERICAN

Probably many readers of the SCIENTIFIC AMERICAN have wondered what phenomenon would appear were the sun to be annihilated instantly. Many, I suppose, thought that the light would be shut off immediately.

With the following explanation and accompanying diagrams I shall attempt to show what the result would be.

The diameter of the sun is known to be roughly 866,000 miles, and the speed of light to be 186,000 miles per second. Now, while the light of the sun appears to come from a disk, it really comes from a curved surface, the center of





which is nearly 433,000 miles nearer us than the edges. Let *A*, *A'* be the visible portion of the sun. (The figure is a cross section.) Then the light from the point *B* has a shorter distance to travel to the surface of the earth by 433,000 miles, or more than 2.3 *light seconds*. Therefore, the light from *B* reaches the surface of the earth 2.3+ seconds before the light from *A*, *A'*.

Now, supposing the light all over the sun should cease instantly. The light from *B* would stop 2.3+ seconds *sooner* than the light from *A*, *A'*.

Therefore, if the sun were suddenly annihilated, if one were observing at the time, about eight minutes (the time light takes to travel from the sun to the earth) after the sun would appear black at the center, gradually increasing, until 2.3+ seconds after the sun began to grow black, it would be entirely invisible.

Viola, Idaho. K. M. ADAMS.

Why do Not Human Eyes Shine at Night?

To the Editor of SCIENTIFIC AMERICAN

When hunting at night, one can see the eyes of animals shine pale green or red, when artificial light is directed on them; the same is seen when motoring at night with sheep, cattle, dogs, cats, etc. But this is never seen with human eyes. Why is it? The eyes seem to be made exactly alike. I think the above subject has never before been discussed, in fact, when I speak to anyone about it they say they have not noticed it. WALTER WYMANS.

Surrenden Park, Pluckley, Kent.

[Your question "Why do Not Human Eyes Shine at Night?" is not difficult to answer. The coat of the eye which carries the blood vessels, otherwise known as the *choroid coat*, is locally differentiated into a structure called the *tapetum*. This tapetum, situated on the back portion of the choroid coat, varies widely in different animals, both in appearance and detail of structure.

In the cat the tapetum, formed by a layer of cells containing crystals, is of a brilliant blue or green color, and it is the reflection and incident iridescence of light falling on this area that causes the eye to "shine" in the so-called dark.

I have kept a cat's eye preserved in

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With these tires you save rim-cutting. You save the blowouts due to overloading. You get extra capacity without extra cost. For those patented tires now cost no more than other standard tires.

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Now Double-Thick Non-Skid Treads

Now we have added, for those who want it, a double-thick Non-Skid tread.

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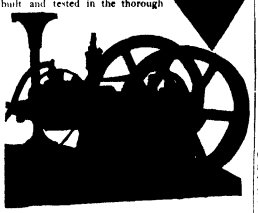
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glycerin jelly for five years, which still shows undiminished iridescence when a ray of light is allowed to fall upon its tapetum. The eye of a horse kept for a like period gives the same result.

In man the tapetum is insignificant, and therefore the phenomenon of "shining" at night is not observed. Between the tapetum of man and that of the cat we find all grades of development in the other mammals, and a critical examination will show that the degree of "shining" in the dark will vary according to this development. R. W. Tower, Curator of Physiology, American Museum of Natural History, New York.]

Association of Variable Star Observers

To the Editor of Scientific American:

Notice is hereby given that an association of variable star observers has recently been organized in this country. All those interested in astronomy possessing telescopes of three inches aperture or larger are cordially invited to co-operate in this work. This plan has received the indorsement of Prof. E. C. Pickering, director of the Harvard College Observatory, and monthly reports of the work of this association are sent to the Harvard Observatory. Here is an excellent opportunity for observers to render science practical aid, and use their telescopes to good advantage. The work is not difficult, involves no mathematics, and requires no experience. Those desiring further information respecting this line of observation work are requested to address

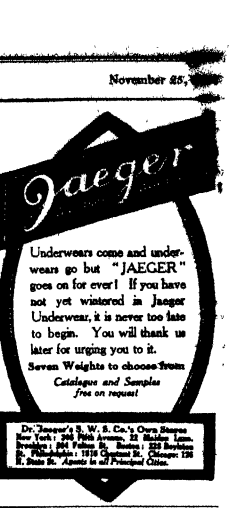
William Tyler Olcott.

Norwich, Conn

Zeppelin's "Schwaben"

(Concluded from page 478.)

honored aeroplane rudders, fore and aft, were removed—quite a revolutionary step, because they had always proved efficient. Only one set of them was now attached to a more graceful single rudder frame at the extreme rear, where they were combined with vertical rudders and cleverly supported by the stabilizing fins. It was found that thus friction and head resistance was cut down, steadiness improved and the efficiency of all rudders wonderfully increased, for the big ship could now be turned completely within a circle of only 1,600 feet in diameter. It was surprising that the lifting power of the ship suffered nothing from the removal of its "aeroplanes;" the kite effect of the smooth cylindrical hull so well replaced theirs that instead of falling below the floating power of the "Deutschland," that of the "Schwaben" was essentially increased by her greater speed. The efficiency of an aeroplane which is very long in its line of motion is improved in a dirigible by the small weight it has to carry dynamically per square foot of its immense surface. Incessant experimenting with propellers is going on in the Zeppelin laboratory, and the "Schwaben's" large four- and two-bladed ones showed increased efficiency. The brackets holding them were cleverly robbed of much head resistance and turned into useful and ornamental steadying fins by a cloth covering. Structural strength was increased at the essential points. The cars and the cabin were built of corrugated aluminium. The size and strength of the pneumatic buffers under the cars was increased. The success of the "Schwaben's" many passenger trips is not only due to her own greater power, but also to perfected methods of handling rigid dirigibles. There are mechanical docking devices in the new sheds which hold the ship securely until it is safe in the open air, so that it may enter and leave without danger. A rail on each side of the shed runs far out into the open through each of the doors at both ends. Each length of rail is made of two narrow channel plates, rivetted together back to back. Two sets of rollers run on each rail, each set bearing against the underside of the upper flanges. Four steel cables depending from the airship's frame can be made fast to the four sets of rollers and may all be slipped simultaneously. The two rails are so far apart that a dirigible lashed to them cannot be swayed if it has sufficient lift, and this may be obtained by removing passengers and bal-



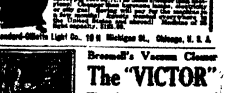




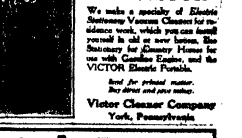
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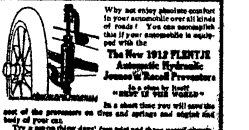
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last during the time that the airship is pushed in or out of its shed. Starting a flight means simply to take aboard passengers and ballast after the ship is at a safe distance from the menacing walls of the shed, and instantly to release all the hawsers But entering the shed with a brisk wind blowing at right angles to its axis and to the rails is more difficult. In this case the ship is halted in the open over the track, pointing into the wind. One of the front cables is fastened to the rollers nearer the shed on the windward rail. With this set of rollers as a fulcrum the ship is worked around by pulling at the rear end, steadying it along the sides, and simultaneously pulling the lee side down, until it becomes parallel to the rails It is then a simple matter to fasten the remaining cables, unship passengers and ballast, and roll the ship as safely into the shed as though it were a train of railroad cars

It may be worth noticing that this device is the same, though more primitive and still depending on the co-operation of a great number of men, as the one suggested in the SCIENTIFIC AMERICAN directly after the accident to the "Deutschland II."

Of equal importance to the docking of these big ships is their safe anchoring where there are no sheds. A safe anchorage over unobstructed grounds, mostly parade grounds, has now been prepared near almost every German city The holding device is a development of the method by which in the past severe squalls occasionally have been weathered It is different in so far that the pivotal point around which the ship freely swings into the wind's direction is now not on the ground but in the ship's own frame Even with the short single bow cable formerly used successfully, jerks which strained the frame and the cable were not entirely avoided in gusty winds (Too much play for the bow In the accident at Limburg snapped the long cable and freed the ship, though it did not damage the frame)

In place of one cable there are now four, giving greater safety They are part of the ship, and may be seen hanging from the bow They are fastened to a ring that pivots around a strong pin in the reinforced framework To anchor the ship, they are made fast with their free ends to four heavy cubes of concrete, each 3¼ feet in diameter, sunk into the ground, and so arranged that the four cables evenly radiate toward them from their pivot on the bow. Thanks to its rigidity, the ship now turns around the apex of this pyramid of cables, as smoothly as a new weather vane around a steeple Unshipping ballast at the bow makes this pyramid very rigid.

Weather "Kiosks" at Home and Abroad

(Concluded from page 477.)

maximum and minimum thermometers set, etc., by an employee of the local Weather Bureau station

As a substitute for the ill-exposed and often ill-constructed drug-store thermometer the kiosk amply justifies its existence in providing an accurate record of the conditions to which the urban population is exposed In hot weather the thermometers in the kiosk read many degrees higher than those of the regular Weather Bureau station. The following comparison of maximum readings during a summer hot spell at Washington is instructive:

July, 1911.	Weather Bureau Observatory	Kiosk.
	Degrees Fahrenheit	Degrees Fahrenheit
3	97.7	106.0
5	99.1	106.5
4	96.7	106.0
5	97.8	104.5
6	98.3	108.5
7	95.0	102.7
8	84.2	93.5

When a brisk wind is blowing the difference between observatory and kiosk temperatures is less than shown by the above comparison. The propriety of artificially ventilating the kiosk—the plan adopted in a type of kiosk used in Germany, as described below—has been con-

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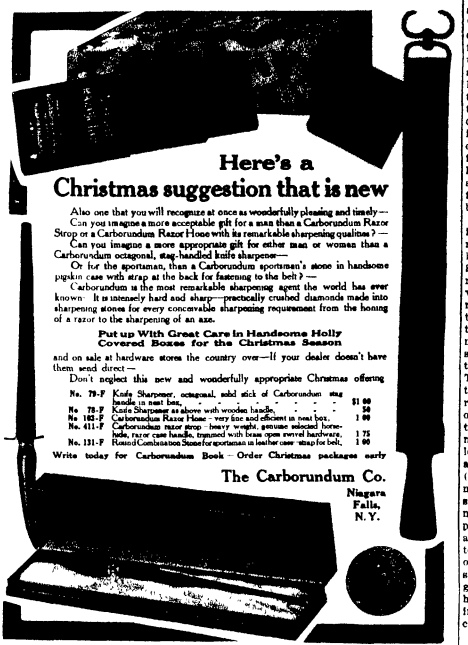
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sidered. It is a question, however, whether the structure with this modification would answer so well the purpose for which it is intended; since the populace, whose environment the kiosk instruments are designed to gage, does not habitually carry an electric fan about the streets, nor even continually wield the palm-leaf in the busy round of daily occupations. On the other hand, neither is the populace inclosed in a cast-iron cage, and possibly finds itself more comfortable in hot weather than would the kiosk thermometers if they had human sensibilities; so that the question of artificially ventilating these structures may be regarded as an open one.

The meteorological kiosks of Europe, in contrast to those just described, are not maintained by the official meteorological services of the several countries Some have been erected by instrument-makers, as a means of displaying their wares; others are installed at health-resorts, as an attraction to visitors; but the majority are mere sign-boards for the display of miscellaneous advertisements, which occupy most of the surface space. The instruments being relegated to any odd corner that can be spared Their architecture varies according to the taste of the designer, without, as a rule, any regard to the proper exposure of the apparatus Some of these structures, especially those erected by the municipalities, are most imposing—to look at One built some twenty years ago by the city of Berlin cost 7,000 marks ($1,666) In this structure the instruments were installed behind glass in shallow unventilated panels, and in summer all of them were exposed during part of the day to direct sunshine The apparatus included a mercurial barometer hung at such an elevation that no one could read it without the aid of a step-ladder All the instruments were grossly neglected, and those that should have shown identical readings exhibited instead the most remarkable discrepancies.

Latterly, however, certain foreign instrument-makers, especially in Germany, have turned their attention to the production of kiosks satisfying scientific as well as popular and artistic requirements Probably the first German kiosks to be constructed according to scientific principles were those erected in Berlin about 1891 by the Urania Uhren- und Säulen-Gesellschaft, and known as "Uraniasäulen" (Fig 4) These were intended primarily for displaying advertisements, but contained well-constructed and well-exposed meteorological apparatus, ventilated by a clockwork-driven fan, according to the principle of the Assmann aspiration-psychrometer Unfortunately the Urania Company did not have a long career; the kiosks were bought by the municipality, and in most cases deprived of their instruments In a few, however, the instruments are still kept in operation.

Excellent weather kiosks are now manufactured in Germany, though one sees plenty of the opposite kind at the "Kurorte" and other frequented places in that country The type of kiosk constructed by R Fuess, of Steglitz, near Berlin, is shown in Fig 3 This contains a barograph, hygrograph, and thermograph, the pens of which trace their records on a sheet of paper wound around a single revolving drum The apparatus is ventilated, according to the Assmann method, by a revolving fan, driven by electricity or water-power—usually the latter Kiosks are also manufactured on a large scale by W. Lambrecht, of Göttingen (Fig 1) and usually house some of his special instruments; such as the "polymeter" and the "weather-telegraph." The latter comprises a particular form of hygrometer and an aneroid barometer, the dials of which stand side by side; while underneath is a series of diagrams which, it is claimed, enable one to forecast the weather from the indications of the two instruments.

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(Concluded from page 478.)

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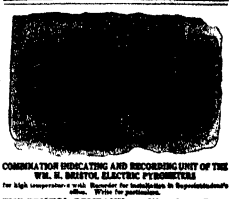
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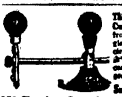
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economics laid down in such a course has the assurance of being in demand as long as this country remains a great industrial nation. In these days, when the industrial needs of the land are growing so rapidly, the demand for electrical engineering graduates who come from the best planned and administered engineering schools is very great, and, as long as the industrial growth of the nation continues, the demand will continue to absorb all well trained young men that the schools can supply.

An experienced engineer should have the ability to conceive, originate and direct extended industrial enterprises. To attain this ability requires many years of mature experience, and an electrical engineering course that is expected to promote the highest welfare of its graduates must be largely occupied with teaching the principles of science, i. e., the purport of known natural laws and their relations to each other. Young men with this sort of a training are not seasoned engineers, but they have the training which gives them great capacity for becoming engineers and after sufficient experience in actual practice of obtaining the highest rank consonant with their individual abilities. This great capacity for becoming efficient engineers through the seasoning effect of experience, which engineering graduates possess, is a sufficient reason for their being in demand. Such graduates have opportunities for professional usefulness in many branches of electrical engineering.

In telephony the work is primarily one of unending detail, but it may lead to broad and comprehensive executive duties in connection with one of the great servants of commerce, and the telephone service offers so many opportunities of benefiting the public that it has attracted a great many able men to its ranks. In electric railroading is found a rapidly growing branch of service that appeals to the imaginations of many. There are opportunities in it leading to executive duties in a branch of industry that composes the very backbone of commerce. With the present tendency toward electrification of the great terminals and mountain divisions of trunk line steam railroads and even of their main stems, the graduate of an electrical engineering course who goes into railroading with the firm purpose of learning the best processes of handling traffic has possibilities of a great career before him.

Similar attractions are found in electric light and electric power transmission and attractions of other kinds and unending variety are found in the manufacturing industries, but it should be remembered that most of the men capable of deserving the highest positions within the sphere of electrical engineering practice must expect to become either men of executive force or men who originate new projects or machines. In either of these vocations it will be found that far more than a trades education is needed and that the appropriate education must be, broadly speaking, the education of a gentleman, a man of the world, and a scientist. Such men find use for all of the scientific studies already named and also for the training in language, history and political science which has now come to an honored place in the curricula of a few of our engineering schools.

There is also at the present time a considerable call for competent teachers in electrical engineering courses, and the work of research in regard to electric and magnetic phenomena is growing rapidly and is calling for workers.

When the field of electrical engineering is examined in this manner, and the experience of the able young men who are now graduating year by year from the electrical engineering schools is compared, there can be no other conclusion reached than that electrical engineering as a profession offers opportunities for those who have industry and a taste for science and business which are not excelled in any profession or branch of business. Experience shows that there are opportunities in electrical engineering for all well trained young men who possess good sense and industrious habits, and particularly for those who have the ambition, capacity and industry to digest a course at one of those few schools which stand in the first rank of scientific accomplishment and earnest endeavor.



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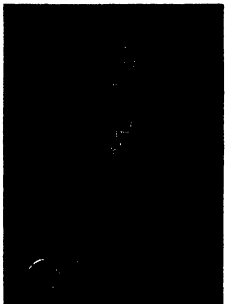
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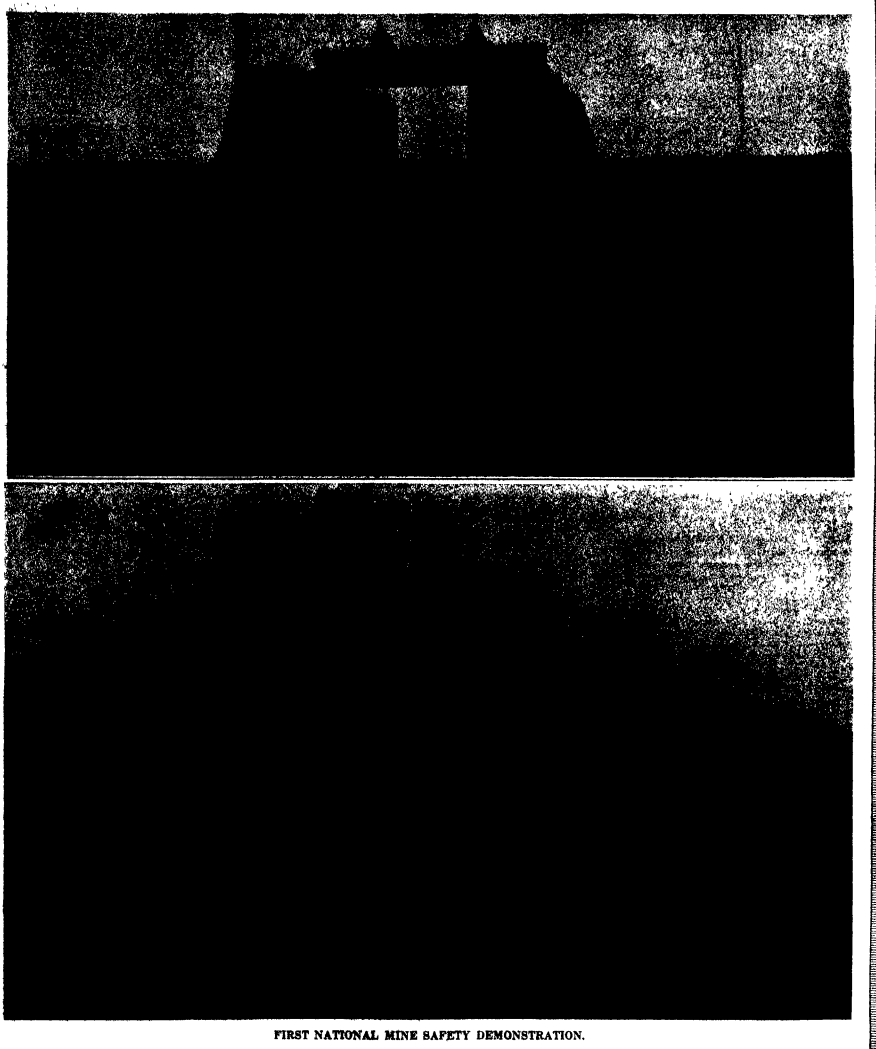
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The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

The purpose of this journal is to record accurately, simply, and interestingly, the world's progress in scientific knowledge and industrial achievement.

Our Trade With South America

AMONG the subjects of national importance which should command the attention of every enlightened citizen of the United States is that of the trade of South America and our own particular relation thereto. We commend for careful perusal the bulletin of the Pan-American Union for October, which deals with the trade of Latin America for the year 1910. The growth of the commerce of the twenty republics dealt with since 1897 is shown by the fact that whereas in that year the total commerce was $910,422,500, in 1910 it had increased to $2,848,744,000, a gain of over 150 per cent, which is about equally divided between imports and exports. These figures reveal the important and unsuspected fact that in the matter of commercial expansion Latin America has forged ahead more rapidly than the United States, the growth in foreign trade during the period referred to being $1,339,000,000 for the Latin American republics, and $1,581,000,000 for the United States.

During 1910, 55.2 per cent of the imports into the republics of North America came from the United States and to the South American republics we sent 13.64 per cent of their total imports. Taking the whole group of the Latin American republics, both in North and South America, we find that the United Kingdom leads with 26.03 per cent of the total imports, followed by the United States with 23.31 per cent. The third place is held by Germany, with 13.4 per cent, followed by France, with 8.21 per cent. The United States lead in the matter of exports received from Latin America, with 34.51 per cent, the United Kingdom, with 20.99 per cent, being second, Germany, with 11.47 per cent, third, followed by France, which takes 8.29 per cent of the exports. Seventy-five per cent of the shipments from the republics in North America come to this country, but we receive only 20.8 per cent of the shipments from the southern republics.

We are free to confess that the results shown in this bulletin are more favorable, as regards the position of the United States in the Latin American trade than we had supposed them to be. At the same time, in view of the great geographical advantage enjoyed by this country, as compared with our commercial rivals in Europe, our trade with the southern republics is far below what it should be. A better system of banking, one more adapted to conditions in South America, the exercise of greater care in selecting the representatives of our commercial houses who go down and get into personal touch with the Latin American business men, a more intelligent study of the character, disposition, tastes, manner of doing business, and particular ways and wants of the people down there—all this coupled with the creation of a merchant marine specially constructed for the South American trade, would do wonders in the extension of our Latin American commerce.

Personality and manners count for a very great deal with the Spanish American. There is probably no section of the earth where "bluff," "push," and general "get-there" methods count for so little, except as destructive agencies. The German, always analytical and scientific in his methods, thoroughly understands this fact; and the great commercial houses in Germany select their representatives with a special eye for their fitness for meeting and adjusting themselves to the idiosyncrasies of the Latin American customer. Instead of trying to make the people buy what he makes, the German tries to make what the people buy—a very simple, but a very radical and far-reaching distinction. More than that, he is careful to pack the goods and deliver them in just that very way which will render them acceptable to the customer and fit in most comfortably with his established habits and the general local conditions.

The Quebec Bridge Competition

ALMOST important contribution to the literature of bridge engineering is an article by Gustav Lindenthal, in our contemporary, *Engineering News*, on the Quebec bridge competition, which not only throws a flood of light upon the inside history of this great undertaking, but also affords a mass of instructive technical information for those who are interested in the construction of long-span bridges.

The Quebec bridge owes its celebrity mainly to the fact that it contains a longer single span than any bridge as yet constructed, its nearest competitors being the Brooklyn suspension bridge, with a main span of 1,595 feet, the Williamsburg suspension bridge, which measures 1,600 feet between towers, and the Forth bridge in Scotland, a cantilever structure, with two main spans, each measuring 1,710 feet in the clear. The cantilever structure which is to be built near Quebec will be 1,800 feet in the clear between centers of main piers.

In 1889 the Quebec Bridge Company invited tenders for a structure to carry a two-track railroad with a wagon road and trolley line on each side. Out of six competitors, the Phoenix Bridge Company was awarded the contract for the construction of a cantilever bridge prepared by its own staff of engineers, the award being made on the ground, among others, that this company's plan was the lowest in price. The construction was commenced, and when one-half of the bridge had been erected, the structure collapsed under its own weight, with the loss of eighty lives and four million dollars in property destroyed. "The primary cause of both disasters," says Mr. Lindenthal in the article referred to, "was the same: bad engineering; but in connection with the Quebec bridge was a contributory circumstance, of which it is difficult for engineers to speak without a feeling of humiliation, and that is the beggarly compensation for engineering services on a work of unprecedented magnitude, and the willingness of an engineer of high reputation and unimpeachable integrity to assume very important and laborious duties for a fee for which they could not possibly and seriously be met."

In this connection we wish to emphasize the fact that in all great engineering works of this character, the very last direction in which economy should be practiced is in that of the employment of the highest type of professional men, both for the design and oversight of the work. When such men are engaged, the remuneration should be on a scale which will justify them in allotting that measure of their own time and of the time of their office and field force, to the work, which the importance of the job demands. We need go no further back than the recent failure of the Austin dam for another object lesson in the folly of practicing overzealous economy in the matter of professional engineering services.

The bridge fell because one of the main compression members in the bottom chord of the shore or anchor span, which had been designed to stand a pressure per square inch of about 80,000 pounds before beginning to give way, failed suddenly and without warning under about one-half that load, or to be exact, under 16,800 pounds per square inch pressure. Mr. Lindenthal scouts the theory advanced in some quarters that the blame is to be ascribed to lack of scientific knowledge of compression members, which it was alleged could be derived only from full-size tests of large columns. He rather lays it to the fact that no studies of any kind were made for the unprecedentedly large compression members of the Quebec bridge until after their failure. Says he, "The leading consideration for the choice of their cross-sections seems to have been the desire of the contractor for cheap manufacture, which was not balked by the engineer. The chord members consisted each of four slabs or ribs composed of a number of thin, stitch-riveted plates, with contact surfaces painted or rather greased, insufficiently stiffened with flange angles and flimsy lattice angles. They were of a form so obviously defective that they should have been condemned at first sight. They were a pernicious example of commercial engineering, which may be defined for this case as the subordination of design to the cheapest method of manufacture, under the pretense of fulfilling specifications."

The fall of the bridge was investigated by a Royal Commission of three Canadian engineers, who made an exhaustive and able report. Unfortunately the Canadian Government dispensed with the aid of that commission, whose report formed the basis of favorable comment at the time in the columns of the SCIENTIFIC AMERICAN, and appointed a new board, which, after much labor and time brought forth an official design, which, according to Mr. Lindenthal, cost the Canadian Government about five hundred thousand dollars and two and a half years' time of the Board. Bids were invited on this design, and bridge companies were invited to submit designs of their own; but they were expected to prepare these in four months' time and without any compensation whatsoever. Ultimately, out of the many and costly competitions, which included about twenty-four tenders and eight or nine competitive plans, and tenders varying from eleven million to sixteen million dollars, an independent design, drawn up by a Canadian company "in contravention of the official specifications," providing for limited traffic capacity and costing only nine million dollars, was accepted by the Canadian Government.

Had the design for this bridge been thrown open for world-wide and unrestricted competition by the leading bridge engineers of the world, the Canadian Government would undoubtedly have secured a better bridge, and certainly would have saved an enormous sum of money. In the latter half of his article, Mr. Lindenthal, himself probably the leading authority on long-span bridges, will show that the Canadian government ultimately will have spent nearly eighteen million dollars by the time the St. Lawrence River bridge is completed, and this in spite of the fact that by a wise and judicious policy it could have secured a bridge of greater capacity with a large margin of strength, for a sum of less than ten million dollars.

Attempts to Produce Experimental Pellagra

SO far the study of the horrible disease known as "Pellagra" has produced nothing to point to the etiology of the disturbances it sets up. The Italian expert, Dr. Sambon, believes that it is an infectious disease, and that it is transmitted by the "buffalo gnat" (*Simulium reptans*); Dr. Lavinder, the specialist of the United States Public Health and Marine Hospital Service, thinks that the disease is a metabolic or food disease. But until the past year no one had tried to test the various theories by means of inoculations in one of the higher animals.

If Sambon's theory is correct, an infection should be possible by means of the blood of a patient, since the organism that causes the disease must at some stage or other be present in the blood. To test this supposition, Dr. John F. Anderson, director of Hygienic Laboratory, and Past Assistant Surgeon Joseph Goldberger obtained some rhesus monkeys (*Maccacus rhesus*) and inoculated them with defibrinated blood and spinal fluid from typical cases of Pellagra. Two of the monkeys showed slight discolorations of the skin on the face; these varied in intensity and disappeared after a short time, and they were different in the two monkeys. There was no fever or any other indication of disturbance after nine months.

Dr. C. H. Lavinder, although he does not believe the disease to be due to infection, also attempted to induce the disease in a number of rhesus monkeys. In three monkeys he made intraperitoneal injections of blood from a patient, in three injections of spinal fluid, and in three injections of spinal emulsions. The emulsion was also used to inoculate culture tubes, with negative results. After six months, none of the monkeys showed any symptoms.

Drs. Anderson and Goldberg suggest that the negative results may be explained in one of three ways:

1. The monkeys may not be susceptible to the disease.

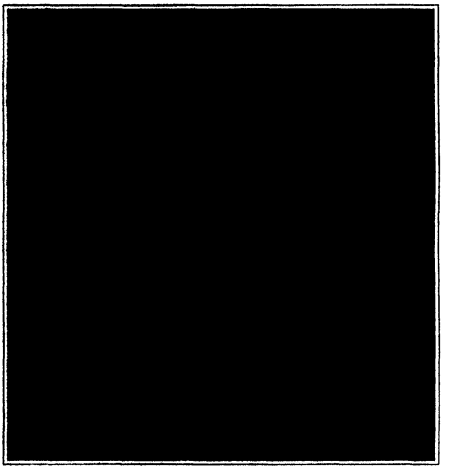
2. The technic may have been defective.

3. The infective substance or agent may not have been in the blood or in the spinal fluid at the time it was drawn.

These explanations all assume that the disease is infectious. But even on that assumption there is still another explanation possible. If the disease is caused by an animal parasite and is transmitted by the *Simulium*, there is the possibility that the organism undergoes developmental changes in the secondary host, without which it is incapable of producing the disease again.

Hudson Maxim

A Noted Inventor of High Explosives



HUDSON MAXIM

Best known for his work in high explosives and their application to modern ordnance.

ALTHOUGH the subject of the present sketch has been a close worker in many fields of activity, he is known in connection with his work in the manufacture of high explosives and their application to modern ordnance.

Hudson Maxim was the fourth son of a family of eight children, six boys and two girls. He was born October 3rd, 1853, at Orneville, Piscataquis County, Maine. His parents, Isaac and Harriet Boston (Stevens) Maxim, were of sturdy stock of English and Scotch descent.

In early years he formulated the hypothesis of the compound nature of the so-called atoms, which has only recently been generally accepted as a proven theory through experiments on radiant matter. His theory, as first published in brief in the SCIENTIFIC AMERICAN Supplement, No. 697, of May 11th, 1889, is that all matter is composed of the ultimate, and that the difference in the various forms of matter and manifestations of force is due to the difference in the relative positions of the ultimate atoms.

From 1883 to 1888, Mr Maxim was engaged in the subscription book publishing business at Pittsfield, Mass., and during this period he wrote and published a book on "Penmanship and Drawing" of which nearly half a million copies were sold by subscription. In 1888, he left the publishing business for the more fascinating occupation of inventing and experimenting with ordnance and explosives.

In 1890, he erected a dynamite and smokeless powder mill at Maxim, New Jersey, where he developed and manufactured the first smokeless powder to be adopted by the United States Government. The E. I. duPont de Nemours Powder Company, of Wilmington, Delaware, purchased his inventions and patents, employing him as consulting engineer and expert in experimental work and exhaustive experiments by the United States army at Sandy Hook. Mr. Maxim sold this Government in 1891 the secret of his high explosive Maximite. It was the first high explosive to be successfully employed as a bursting charge for armor-piercing projectiles.

Among the others of his successful inventions is a detonating fuse for high explosive projectiles, which has proven itself superior to all rival fuses, and has been recently adopted by this Government. A later invention is stabillite, a new smokeless gunpowder, which in addition to other desirable qualities, has the great advantage that it may be used as soon as produced. This, in view of the fact that ordinary nitro-cellulose smokeless powder requires several months to dry, renders stabillite of the greatest importance in the event of war. For the largest guns, more than a year is often required to dry out the solvent. Stabillite does away with all this difficulty.

Simultaneously with the invention of stabillite, Mr. Maxim produced a new self-combustive compound, which he named motorite, intended to be employed instead of compressed air for driving torpedoes of the Whitehead type. The motorite is made in bars about five feet long and seven inches in diameter. These bars are then coated on the outside and forced and welded into steel tubes. The bar is ignited at one end to which the combustion is confined until the bar is entirely consumed. Water is forced into the combustion chamber and is instantly converted into steam by the flame blast, the products of combustion and the steam mixing to produce a motive fluid which is employed to drive a turbine or other engine.

There is probably none of his inventions upon which Hudson Maxim has expended more time and effort than upon this. In addition to driving torpedoes it is also applicable for driving small torpedo-boats during the run of attack, and Mr. Maxim has designed a new type of torpedo boat, which itself forms a veritable torpedo, driven by motorite during the run of attack through the gun-fire of a warship. The boat will carry a load of high explosive in the warhead, which will be discharged against the hull of the war vessel attacked.

The process of making calcium carbide continuously by the electrical resistance of a molten carbide conductor, removing the carbide as fast as formed, and simultaneously supplying fresh material to the heating fluid, now in general use in this country, was invented by Mr. Maxim, the invention being sold to the Union Carbide Sales Company in 1906. During experiments in the manufacture of calcium carbide, he invented a process for the manufacture of microscopic diamonds by electro-deposition.

Another late invention of his is a game of skill—an improvement on chess, it is called the War Game, the movements of the pieces simulating field operations of troops in battle.

He is the author of "The Science of Poetry and the Philosophy of Language," published by Funk and Wagnalls, 1910. The work embraces an exhaustive treatise on the nature and use of sounds in language, and contains many important scientific discoveries in the constitution and dynamics of human speech.

From the foregoing one can easily appreciate what a hard worker and tireless thinker this man must be, and yet, aside from inventive labors, he has won acknowledgment as writer, critic, philosopher and sociologist. He is an effective public speaker, and is also a frequent contributor to the leading periodicals on a wide range of subjects.

He is a member of the following societies: The Aeronautical Society of New York (of which he is past president); The Military Service Institution, Society of Chemical Industry, Chemists' Club, Navy League, Fellow of the American Association for the Advancement of Science, Director of the New England Society, 2nd Vice-President of the Aero Club of New York, President of the Hopatcong Rifle Club.

Mr Maxim has had a great many narrow escapes in his long experience as an inventor and manufacturer of explosive compounds. In the manufacture of explosives, even after the work has become thoroughly systematised and the duties of the workmen become routine, there is an inseparable element of considerable danger; but in pioneer inventive work and experimentation with explosive materials, the risk of life and limb is very much greater for the reason that the experimenter is obliged to deal with unfamiliar compounds and unfamiliar reactions under unfamiliar circumstances.

The pathway of the inventor of explosive materials is like that of the vedettes of an army passing over a road planted with the torpedoes of the enemy. One becomes accustomed to the danger of explosives, Mr Maxim says, just as a veteran soldier gets used to the dangers of battle; but it does not lessen the risk.

One day, seventeen years ago, at his powder works in New Jersey, Mr Maxim was experimenting with a new fulminate compound, one of the most dangerous and deadly explosives known to science, when, owing to a little oversight, his left hand was blown off to the wrist.

At another time, at the same place, when one of his assistants was weighing out some of this dangerous material in the laboratory, an arm supporting the scoop of the scales gave way and a weight fell striking within an inch of a quantity of fulminate which was piled on a piece of glass. Had the weight struck the glass, there would have been an explosion, and as there were ten pounds of fulminate in a jar standing on a bench, the explosion would certainly have had fatal results.

At another time, requiring some dry guncotton for an experiment, and not finding a suitable vessel to put it in, he was delayed a few minutes until one should be cleaned. During those few minutes, the guncotton house where he was going for the material blew up. At another time Mr Maxim was conducting some experiments in throwing aerial torpedoes from a 4-inch cannon. These projectiles, charged with a high explosive, were fired into a sand bank one hundred yards distant. The line of fire being parallel with a line of railroad about one thousand feet away, no danger to the railroad was suspected. Several torpedoes had already been discharged and the gun was being reloaded when the whistle of a passing train was heard. The gun was fired, but the aerial torpedo, instead of striking into the bank and exploding, as the previous ones had done, glanced from the bank, mounted high in the air, and passed clear over the train into the swamp beyond, where it exploded with terrific force.

Once when he was conducting some experiments with motorite, the combustion chamber exploded like a bombshell, blowing the windows of the workshop into the street, while the walls were pierced with fragments in all directions. Mr Maxim and his assistant, though both standing in the room at the time, escaped without a scratch.

A smoker is often unintentionally the cause of many a conflagration, the exploder of fire damp in mines, and the cause of the blowing up of powder mills. No smoker and no one carrying matches is ever knowingly admitted into any powder mill or dynamite factory.

One occasion when Mr Maxim confesses to have been thoroughly scared was when an intimate personal friend, a habitual smoker, escaping the vigilance of guards and assistants, entered one of the buildings at Mr Maxim's experimental works on Lake Hopatcong, with a lighted and partially consumed cigar in his mouth, having an inch of hot ashes and cinders on the end of it ready to drop off at the least jar. When Mr Maxim caught sight of him he was standing over a large box containing fifty pounds of dry guncotton, examining the material with his hand, and upon the same bench where the guncotton rested were two other boxes filled with smokeless gunpowder, one hundred pounds in each. Mr Maxim went up to the smoker, threw a cover over the box, and quietly asked him please to stand back a little. Then he told him what he had done, and the offender was so scared that he nearly fell to the floor.

Technical Experts at German Consulates

IT is reported that the German government is about to create a new class of consular officers, viz., technical experts, who will be attached to important consulates and whose duty will be to follow the progress of industrial development in the country to which they are assigned, and to report on all novelties of a technical character. These officials will supplement the commercial experts already attached to many German consulates, who, though they are of great value in furthering the foreign commerce of the fatherland, lack the professional training necessary for answering the many technical questions addressed to the consulates by German manufacturers, engineers, etc. pertaining to the progress of applied science in the several foreign countries.

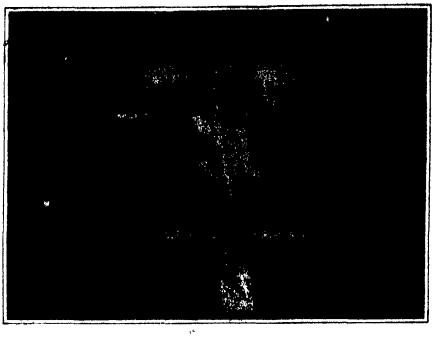
The Hydro-aeroplane

Some of the Latest Biplanes Which Have Been Fitted with Floats in Order to Make Safe Alighting From the Water Possible

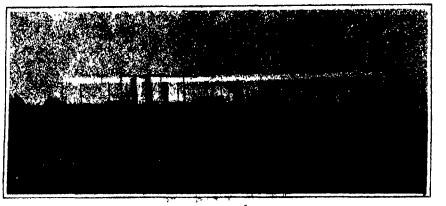
THE first experimenter to succeed in making an aeroplane rise from the surface of the water was the French inventor, M. Fabre, who accomplished this feat with a monoplane of his own invention the last of March, 1910. About a year later Glenn Curtiss, at San Diego, fitted a float to his biplane and made it rise from the water and alight thereon with complete success during the course of his experiments. He flew out to the cruiser "Pennsylvania" anchored off the harbor and was lifted aboard with his machine. After paying a short visit to the ship, the aeroplane was lowered once more and Curtiss flew back to his starting point within the harbor. During the past summer the hydro-aeroplane has been experimented with by officers of the navy and two Curtiss hydro-aeroplanes have been purchased. These machines have found favor on account of their shift control, which consists of a movable wheel in front of the two aviators and mounted upon a vertical arm pivoted at its lower end so that it can be swung in front of either man. By this means it is extremely easy to shift the control wheel of the machine from one to the other pilot whenever it is desired to do so. In their long flight from Annapolis to Hampton Roads recently, Lieuts. Ellyson and Towers found this control of great benefit, as they were able to take turns in running the machine. Quite recently Mr. Curtiss has received a large order for hydro-aeroplanes for the Russian navy, and he has sent one of his aviators to Russia to demonstrate these machines, while Capt. W. I. Chambers of our own navy believes that before long each battleship will have to carry one or more hydro-aeroplanes.

One of our illustrations shows Witmer skimming the surface of the waves in the Hudson River in one of the latest Curtiss machines. This biplane is mounted on a single float, the bottom of which is rounded upward at the front, while the top is rounded downward at the rear end. This float is made of wood and is 14 feet long by 2 feet wide by a foot in depth. It will sustain a weight of some 1,400 pounds without being submerged. The front horizontal rudder is mounted above the bow of the float, where it not only serves its purpose of steering the machine in a vertical plane, but also keeps the spray from striking the aviator. At each end of the lower plane there is an inclined air cylinder which acts as a buffer and buoys up the end in case the machine tips when skimming the surface of the water. Recently Hugh Robinson made a flight in one of these machines down the Mississippi River from Minneapolis, Minn., to St. Louis, Mo., for the purpose of demonstrating its use as a mail carrier. Some five thousand pieces of mail were carried, and mail pouches were taken on and put off at the various towns on the way.

Another of our illustrations shows the "Pelican" of Capt. Hugh L. Willoughby. Instead of a single float, Capt. Willoughby has built two long, narrow floats with upcurved bows, which match the skids on his biplane. These floats are carefully constructed and are sheathed with brass, making them watertight. Their combined weight is but 103 pounds, or some 20 pounds less than that of the single Curtiss float. They will lift 1,200 pounds without submergence. The "Pelican" was fitted with only a 30-horsepower, 4-cylinder, Curtiss motor, which was not quite sufficient to raise it from the surface of the water. Now that he has transferred his machine to Sewell's Point, Va., he expects to fit a more powerful motor, and make flights above some of the streams in that [illegible]. This new hydro-aeroplane is fitted [illegible] rear horizontal rudder [illegible] in unison, the front one [illegible] which the rear one points [illegible] This is a system which [illegible] some time by Farman, [illegible] the Wrights, but Capt. W[illegible] cured patents upon it, [illegible] States and France. Th[illegible] rudders is practically [illegible] they have vertical trian[illegible] and below. Triangular [illegible] fitted at the rear ends [illegible] The inventor also has [illegible] form of throttle control whose action is just the reverse of the usual arrangement, in that when the pedal is pushed the throttle is closed and the engine slows down, while a full movement of the pedal short-circuits the magneto as well.

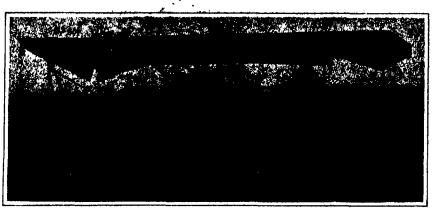


View looking down upon a Voisin "Canard" from in front.



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Rear view of Burgess-Wright headless hydro-aeroplane skimming the surface at full speed.



Capt. Willoughby's hydro-aeroplane "Pelican" resting on its upcurved floats.



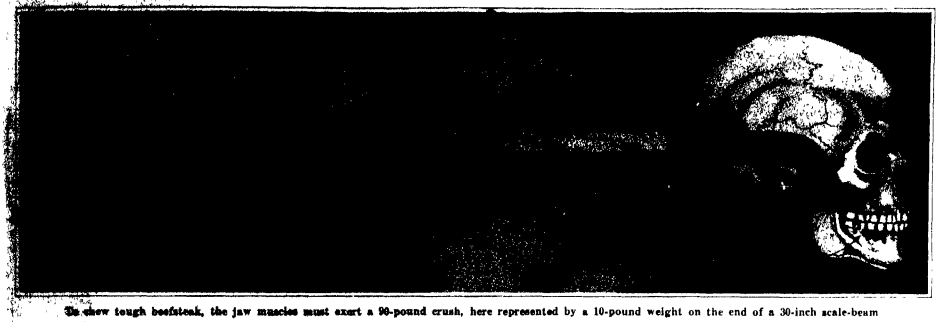
The single-float Curtiss hydro-aeroplane gathering speed in rough water.

THE HYDRO-AEROPLANE

Both the Wright and the Burgess-Wright companies brought out a hydro-aeroplane. A Burgess-Wright biplane, viewed from the rear, is shown skimming the surface of the water in one of our illustrations. Like the "Pelican," it is provided with double floats, but the skids instead of resting upon these floats, are rigidly attached to the aeroplane by means of suitable uprights. These floats are single-step, cedar wood hydroplanes 14 feet long by 2 feet wide, and having a 4-inch step placed about [illegible] the middle.

A fourth illustration shows, viewed from the front and above, the Voisin hydro-aeroplane known as the "Canard" (duck) skimming the surface of the water before soaring in flight. This biplane, which has a long body projecting forward in front, is mounted upon four floats, two of which are [illegible] visible beneath the lower [illegible] about half-way between the body and the ends. The third float is also visible beneath the body about half-way out from the front of the main planes. The horizontal and vertical rudders can be seen at the front end of the body, while the two men in the body are peering over the side as the machine travels forward. The propeller is also visible across the rear end of the body. This machine, mounted on wheels, was described some time ago in the SCIENTIFIC AMERICAN. During the past summer it was fitted with Fabre floats, and has made many successful flights from the surface of the Seine, near Paris. M. Fabre's original monoplane was built on the lines of the "Canard," and was fitted with small floats, placed in practically the same positions as they occupy in this machine. M. Fabre experimented for a long while before he was able to obtain floats that would stand the shocks of the waves and remain watertight. He finally found that several layers of veneer was the most suitable substance for this purpose.

Recently the Aeronautical Society has obtained grounds at Bergen Beach, near New York, for the purpose of making it possible for its members to experiment on the water next summer. As the members are alive to the possibilities of the hydro-aeroplane, without doubt there will be a number of these machines developed next year. The advantage of the hydro-aeroplane is that it can follow water courses that cannot be traversed by motor boats, and can travel much faster than any of these craft. In case of accident or a forced landing, there is always a good place upon which to alight. There are thousands of miles of rivers and canals in the United States above which amateur aviators can fly in safety, and without doubt another year will see a great development in the popularity of the new sport of hydro-aeroplaning.



To chew tough beefsteak, the jaw muscles must exert a 90-pound crush, here represented by a 10-pound weight on the end of a 30-inch scale-beam

The Power of the Human Jaw

The Work We Do In Biting and Chewing

A TEN-POUND bite requires a forty-pound contracting of the human jaw muscles. That is because the jaws are built on the principle of a pair of tongs. The power is applied near the joint, while the work is performed at the opposite extremity of the jaw levers. Had a mechanical engineer designed the human frame, he would no doubt have built the jaws after the fashion of a nut cracker, with the muscles placed at the ends of the jaw levers, and the teeth between these ends and the joint or fulcrum, so that a powerful bite could be obtained with a very small expenditure of muscular effort. However, in the physiology of men and all other animal life, for that matter, mechanical advantage weighs for little in the presence of other broader considerations. This is why nearly all the principal muscles of the body must be far more powerful than would be necessary were they to act directly upon the work. When chewing we have an almost direct application of the power of the muscles, as they nearly overlie the third molars. There is a vast difference between chewing and biting.



The gnathodynamometer.

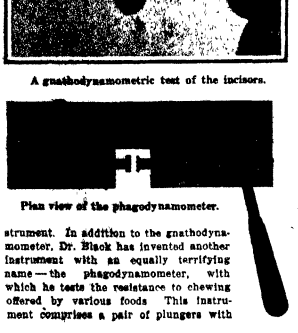
In order to determine the average strength of the jaws, Dr. G. E. Black, president of the Chicago Dental University, some time ago devised an instrument of very simple design but with a name that would put the average jaw to a severe test—the gnathodynamometer. With this instrument he made gnathodynamometric tests of the jaws of a thousand persons. They were selected at random, and probably represent a good average of civilized people. He found that the limit of the bite was not determined by the muscles, but by the teeth themselves. In nearly every case, the patient would cease his efforts, owing to the fact that his teeth hurt. This would depend largely upon the condition of the peridental membranes, and upon the habits of the patient in accustoming his teeth more or less to chewing hard foods. The average of the thousand persons showed 171 pounds for the molar teeth and much less for bicuspids and incisors. Out of the one thousand persons, seventeen developed a force equal to the full registry of the instrument, which was 375 pounds.

In a recent publication, Dr. Black has tabulated the records of about fifty persons who were tested with the gnathodynamometer. The list includes men and women of all classes, from a blacksmith to a Chinese missionary, and from a servant girl to a music teacher. It is natural to picture a butcher as a man with a well-developed and powerful jaw, but among the patients in the fifty the butcher showed a power of only 165 pounds with his molars, from which we may infer that he is accustomed to selecting tender meats for use on his own table. The man with the highest record was a printer who registered 270 pounds, (but any compositor will admit that printers' pie is tough) while the second honors went to a dentist with 240 pounds. Among the women the highest record reached was 160 pounds, while the lowest was 45. Strangely enough, the schoolgirl who made the latter record was able to register 70 pounds with her incisors, which might indicate that she had accustomed her dental membranes of the front teeth to harder work by biting a pencil, or something of the sort. At any rate she was one of those unfortunates who "bite off more than they can chew." In this list of records, males showed an average of 160 pounds with the molars and 88 with incisors, and females 108 pounds with the molars and 67 with incisors.

The instrument with which these records were made comprises a pair of steel arms, which are normally spread apart by spring tension. Each arm is equipped with a rubber pad, on which the biting is done. When the patient bites the pads, the levers are forced toward each other, and cause an index needle to travel over a graduated arc which shows the force of the bite in pounds. One of the difficulties that had to be contended with was that the full power of the muscles cannot be exerted until the jaws are nearly closed. This made it necessary to reduce the biting pads to a minimum compatible with safety. In selecting patients whose jaw muscles were to be tested it was imperative that the teeth be examined for any indications of decay which would weaken them to such an extent as to cause injury when biting on the in

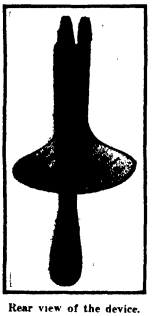


A gnathodynamometric test of the incisors.



Plan view of the phagodynamometer.

strument. In addition to the gnathodynamometer, Dr. Black has invented another instrument with an equally terrifying name—the phagodynamometer, with which he tests the resistance to chewing offered by various foods. This instrument comprises a pair of plungers with toothed surfaces at their adjacent ends. By means of a lever one of the plungers is forced against the other. The latter acts upon a spring, connected with an index needle arranged to sweep over a dial. The pressure of one plunger upon the other plunger may then be read on this dial. With this instrument, some important studies have been made of the force required in the mastication of food. These are shown graphically at the top of this page. In place of muscles the jaw is represented as being provided with a scale beam and a 10-pound sliding weight on the beam. If the weight be moved to the point marked 50, a fifty-pound crushing force will be exerted at the second molars.



Rear view of the device.

The tenderest meat was found to be boiled tongue, the central part of which offered a resistance of from three to five pounds. Boiled tongue, when cold, offered a resistance of from fifteen to twenty pounds. In order to crush pork chops loin, a force of from twenty to twenty-five pounds was necessary. Mutton chops required from thirty to forty pounds, beef, round from forty to fifty, and beefsteak, well done but rather tough, from sixty to eighty pounds. An experienced butcher selected some very tough meats, from the neck of an old animal, which stood up against a force of from seventy to ninety pounds before the crush occurred. These tests were made a number of years ago, before storage meat was used to the extent it is now. The figures should be reduced about one-third for meat made tender by storage. With these data the mathematically inclined may proceed to figure out the horse-power developed at the boarding-house table.

A surprising fact brought out by the use of the phagodynamometer is that the hardness of food does not determine its danger to the teeth. For instance, candies that are quite hard offer much less danger to the teeth than gum drops, which ordinarily are mashed out of shape at from twenty to thirty pounds. If part of the gum drop became wedged between the cusps of the teeth, it was found that frequently it could not be completely crushed with a pressure of less than 350 pounds. Sticks of licorice proved particularly dangerous in this way. But the most remarkable discovery was that even bread might cause the breaking of a cusp. To quote Dr. Black, "With my personal observation, more teeth that seem sufficiently strong have been broken with bread crusts, and not very hard crusts either, than with any other one thing. I used sometimes to feel that persons relating these accidents were not quite honest in their statements, but when I tried the bread and found that it would wedge in between the cusps of the teeth, and not be crushed out with a force of 350 pounds, I changed my mind."

The Manufacture of Yeast

An Important Fermentation Industry

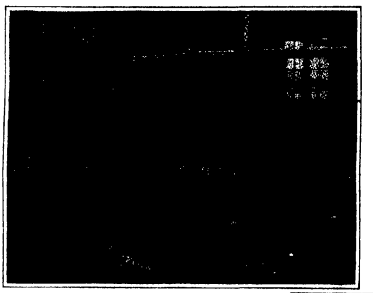
THE ferment used for raising the dough in making bread is a microscopic fungus, so-called yeast, or, as it is called by the biologist, saccharomyces cerevisiæ This organism grows in saccharine liquids, reproducing by budding Its cultivation constitutes quite an important industry, some of the essential steps of which, as carried out in France, are illustrated in the accompanying views The raw materials in this industry are barley, rye, and Indian corn The first operation consists in cleaning this material in special engines provided with metal brushes, sorters, and separators After the dust and other adventitious material has been thus eliminated, a certain portion of the grain is passed through a mill and is ground to flour The remainder of the barley is taken to another part of the plant, located in the basement, where the operation of malting and germinating is carried on In the course of this process a certain ferment known as diastase, is developed in the grain, which has the property of transforming starch into fermentable sugars Throughout the malting operation it is necessary to observe careful precautions in regulating the temperature and humidity, as these factors exercise an important influence upon the proper course of the process The temperature commonly employed is from 12 to 14 deg Cent The ordinary method of germinating the grain requires an extensive floor area and great attention on the part of the workmen and is moreover applicable only at certain times of the year, for if the malting is carried on during the hot weather, there is apt to be a very serious development of mold. This last inconvenience has been very successfully overcome by the so-called pneumatic malting process introduced by Galland and others This consists simply in circulating through the grain a current of air whose moisture and temperature is regulated according to atmospheric conditions and to the particular phase in the process The wet barley is placed in double-walled sheet iron drums or cylinders, through which the regulated air current is passed, while the grain is slowly turned over by rotating the drum about its geometric axis, for which purpose the cylinder is mounted upon four rollers, and is provided at one extremity with a toothed wheel engaging a worm gear The cylinder rotates once in about forty minutes



The fermentation vats.



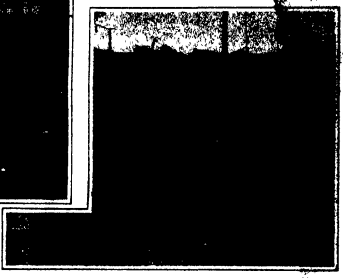
Rotary germinating drums.



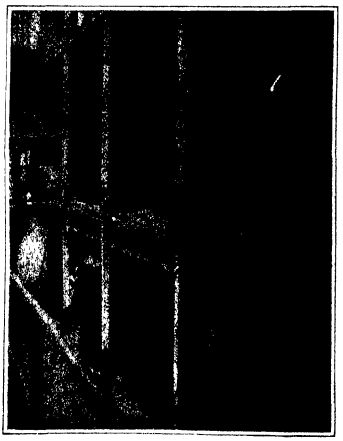
The filter press.

The charging and discharging is effected through a man-hole closed with a door, while a platform gives the foreman access to the drum and enables him to observe the progress of the operation After some eight or nine days the germination is sufficiently advanced, and the diastase is fully developed It is then necessary to stop the operation, for otherwise the young plant would continue to grow, giving rise to other changes than those which are the manufacturer's object. It is time to take the barley out of the malting drum and to proceed to the next operation, which consists in drying the grain at an elevated temperature This is carried out in long rectangular rooms built of brickwork, and measuring about twenty-three by thirty-three feet in length and breadth, and about forty to fifty feet in height. In these hot rooms the barley is spread out upon sheets of metal gauze, in layers about four inches deep, and is allowed to dry gradually A short chimney at the end of the building allows the escape of the water vapor liberated in the process of drying. After the drying operation is completed the grain is next passed on to a riddle, where the rootlets formed during the germination are broken and separated. The grain is next

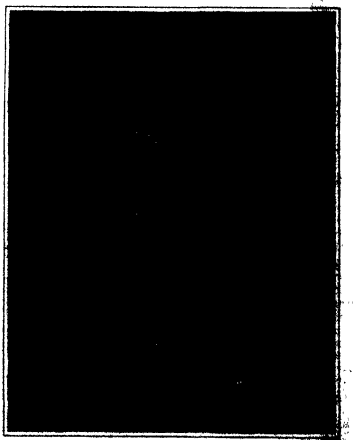
(Continued on page 496)



Packing the malt in bags.



The rectifying stills.



The distilling columns.

Science

Peculiarities of Hail-stones.—The peculiar formation of hail-stones and the probable conditions of their production have long been matters of much interest to scientists. A thorough study of them, it is believed, might throw much light on various meteorological phenomena, especially in regard to air-currents, changes of temperature and of pressure, etc., in the upper strata of the atmosphere. A comparison often made with the "ice flowers" and snow crystals or stars which Tyndall and other prominent scientists have found so fruitful a field of investigation might yield important results. Heretofore, however, the comparative rarity of their occurrence and the great rapidity with which they melt, has offered obstacles to this But Prof. Boris Weinberg, of Tomsk, Siberia, has just perfected an apparatus, as we learn from *Les Annales*, which is expected to obviate these difficulties. He will gather the hail-stones as opportunity offers and preserve them by plunging them into liquid of about the same density contained in a double-walled receptacle like a superior ice cream freezer, but "packed" with a mixture of ice and sulphate of copper As needed for study the stones can be removed, sliced in extremely thin sections and photographed by a polarizing microscope or autochromatic plates, as is done with anatomical preparations.

The Eruption of Taal Volcano, in the Philippine Islands, which took place January 30th, 1911, and caused a loss of 1,300 lives, has been the subject of a large number of important papers in the scientific journals, besides the official reports of the Philippine Bureau of Science One of the most graphic descriptions is that of Rev M Saderra Maso, which is published as a special bulletin of the Philippine Weather Bureau. This account is noteworthy for the attention devoted to the meteorological and seismological features of the eruption, and in this respect it is an important contribution to the science of vulcanology This volcano has been the seat of repeated disastrous eruptions, the greatest of which was that of 1754 All the eruptions of which a record has been preserved have had the same character as the recent one, consisting of violent explosions which hurled the volcanic products to great distances. The huge vapor column of the last explosion rose to a height of from 20,000 to 30,000 feet, and was seen 250 miles away, where it was mistaken for a distant thunderstorm One remarkable feature of the volcano is that no lava has ever issued from it in a liquid state the ejecta being blown to dust and ashes by the pressure of gases or steam. The late eruption appears to have been marked by unusually magnificent displays of volcanic lightning For three days preceding the eruption a constant succession of seismic shocks were felt over a wide area, and they caused much alarm in Manila, until the Weather Bureau located the epicenter in the region of the Taal Volcano The partial vacuum produced at the moment of the explosion and the resulting diminution of atmospheric pressure set up strong winds blowing in toward the volcano. This wind was felt as far away as Manila (39 miles) At points nearer the volcano it assumed almost hurricane violence, impeding the movements of people who were trying to flee against it, producing tremendous waves on Lake Bombon, causing sheets of iron roofing to fly about, etc. At a distance of 14 miles Father Maso saw the cogon grass lying like wheat which had been beaten down by a storm. He is of the opinion that the wind assumed a rotary motion, in accordance with the general laws of storms, so as to produce a transient tornado or whirlwind. The atmospheric waves propagated outward from the volcano were recorded on biographs to a distance of 200 miles

Engineering

Need for Navy Colliers.—The Navy Department has chartered six Scotch steamers and one American steamer to carry coal from Norfolk to San Francisco for the use of the Pacific fleet The Scotch steamers will charge $5.40 a ton; the "J M Luckenbach," the only American vessel that competed, asked $8 a ton, which bid the navy accepted

Test of a 21-inch Torpedo.—A torpedo designed for the navy, during a recent test in Sag Harbor by the Bliss-Leavitt Company, traversed more than ten thousand yards, when fired at a 32-knot speed At 27 knots it covered a range of over 8,000 yards Most of the torpedoes now carried by battleships and armored cruisers have a speed of 35 knots and a range of 5,000 yards.

Dynamite for Farming.—Experiments were recently made in New Jersey to demonstrate the efficacy of a low-freezing explosive in aerating the sub-soil and digging a hole for tree-planting The discharge breaks up the adjacent ground and renders tenacious sub soil porous and sponge-like, thereby favoring a conservation of the moisture It is claimed that a deeper root penetration becomes possible, and that the crops are not so sensitive to spells of dry, hot weather

The Twenty-second Dreadnought,—The "Centurion," launched November 18th at Devonport, is the twenty second dreadnought to be put afloat for the British navy She will have a displacement of 23,500 tons, and a speed of 21 knots The armament will consist of ten 13 5-inch guns and twenty-four 4-inch guns Her armor on waterline and turrets will be 12 inches thick She will have three torpedo tubes for the discharge of the new 21-inch torpedo whose effective range is 7,000 yards

The 1000-foot Vessel.—A dispatch from London says that the White Star Line has ordered from Harland & Wolff a liner which will exceed the "Olympic" by one hundred feet in length As this ship measures 882½ feet, it will be seen that the new vessel will be approximately one thousand feet long Although the report lacks verification, it may well be true, although the question may be asked on this side of the Atlantic "Where will she dock?" Even the White Star docks with their temporary lengthening of one hundred feet would not accommodate such a ship, whose stern would project over 80 feet into the North River

Praise for American Shipyards.—United States shipbuilders recently were paid a flattering tribute by Admiral Garcia, of the Argentine navy. The Admiral recently made a close study of European shipyards in connection with the letting of the contracts for the two battleships which are being built respectively at the Fore River yard and at those of the New York Shipbuilding Company. He stated that in many points of equipment and management, our shipyards are decidedly superior to the most renowned shipyards of Europe—a statement which will not be surprising to those who are familiar with conditions in the best of our home yards.

Expert Testimony on "Olympic" Collision.—The recent summoning by the British Government of Naval Constructor P W Taylor, U S N., as an expert witness in the Admiralty trial in connection with the collision between the "Olympic" and the cruiser "Hawke," brings to mind tests made by Mr Taylor in the model tank at Washington These experiments with four models towed at different speeds and in various positions with regard to one another, show that one vessel overtaking another is repulsed by the forward vessel until an overlap of one-third has been established Then there is a sudden change, the rear vessel being strongly drawn toward the leading vessel

Aeronautics

Fowler's Flight Eastward Across the Continent.—After being stuck in the sand 15 miles west of El Paso, Texas, for eight days with his Wright biplane, on account of a balky engine, Aviator Fowler finally flew over the town and landed within it on November 13th He expects to finish his trip *via* New Orleans and the Southern States

Flight Aircraft with Mortars. Recently the experiment was made at Sandy Hook of firing at aircraft with a 12-inch mortar, which proved that this was an effective weapon for the purpose The mortar fired a shell filled with shrapnel, and the targets were a number of small captive balloons The test proved very successful even with balloons at high altitudes Then a number of balloons were liberated but even with free balloons the average of the hits was good Experiments of this sort are soon to be conducted with aeroplanes as targets

Bomb-dropping from Aeroplanes in Actual Warfare.—According to the latest report from Tripoli an Italian military aviator succeeded in dropping four bombs into the Turkish encampment on November 1st The bombs, which contained picric acid exploded and a few hours later an aerial reconnoiter showed the Turks had vacated the spot Flying over the desert is quite similar to flying over the sea, according to the experience of the Italian aviators but while at a height of 1,000 feet a fine view is obtained, if the aviator ascends 300 feet farther even, the earth is generally concealed by a blanket of fog It is therefore difficult to reconnoiter at a safe elevation The aviator who dropped the bombs also found it difficult to determine what damage had been done It is therefore suggested that a second aeroplane should follow with an observer who can keep the pilot of the first aeroplane informed as to the havoc he is creating

An American Wins French Military Aeroplane Tests.—As forecasted in the article on the French military tests, Charles T Weymann, with his Nieuport monoplane, won the 186-mile cross-country race He covered this distance in 2½ hours as against 3¼ hours required by Prevost on a Deperdussin monoplane, which also was propelled by a 100-horse-power Gnome motor Weymann's Nieuport weighed 484 kilogrammes (1,065 pounds) and carried as much again in live load and ballast Thus over a ton was driven through the air at a speed of 72½ miles an hour for a distance as great as from New York to Philadelphia and back The fact that Weymann carrying so much weight averaged nearly as much as he did with a stripped machine in the International Cup race on July 1st last, is another proof of the small head resistance of the marvelous Nieuport monoplane

Orville Wright's Flights in a Glider at Kitty Hawk.—Upon his return home from his memorable flights without a motor at Kitty Hawk N C—flights in which he remained aloft 7¾ and 9¾ minutes, respectively—Orville Wright said that these motorless flights were the most difficult he had ever undertaken, the conditions under which they were made being much more severe than those ever met with in a power-driven aeroplane Measured with a Richard anemometer the wind one day at the top of the hill had a velocity of from 17 to 25 meters per second (38 to 56 miles per hour), while 12 feet above the top of the hill the wind velocity was still greater There was a difference of 5 meters per second in simultaneous observations made at heights of 6 and 12 feet, respectively Mr Wright believes his experience at Kitty Hawk will be of great assistance in designing new machines to meet severe weather conditions

The Latest Photograph of the Planet Mars

By Mary Proctor.,

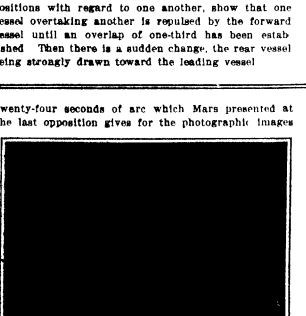
DR. PERCIVAL LOWELL, of the Lowell Observatory at Flagstaff, Aria., has been finally successful in obtaining photographs of Mars, which establish beyond a doubt the reality of the canals of Mars Heretofore, the value of the photos obtained by him in 1907 was questioned, on account of their minuteness, being compared in size to the head of an ordinary pin. Doubts were expressed as to the amount of detail which could be seen on so small a scale, and magnification, it was said, only increased the difficulty by enlarging the silver particles upon the plate, wherever its sensitive surface had been exposed to the light.

With regard to photographs of Mars obtained October 11th, 1911, with the Lowell refractor, 24 inches aperture, the images made at one minute intervals of exposure, each of three seconds, Dr. Lowell writes as follows, in a letter dated November 9th, 1911:

"The following, therefore, will interest you and the public generally—the magnification used for the photographs is now 178 diameters. This on a disk of twenty-four seconds of arc which Mars presented at the last opposition gives for the photographic images a diameter 2.3 times that of the Moon to the naked eye, and a superficies of over five times that presented by our satellite to naked eye vision—rather a surprising revelation this as to the size of our photographs

"Believe me, yours very truly,

(Signed) PERCIVAL LOWELL"



Photographs of Mars, taken at the Lowell Observatory by Mr. E. C. Slipher on October 11th, 1911.

The diameter of Mars at the last opposition was twenty-four seconds of arc less than now Superficies in the above letter, means surface of original photographic images which then covered an area over five times that presented by the full Moon to the naked eye, the telescope magnifying one hundred and seventy-eight diameters While the canals are plainly visible on the photographic plate, they will not bear printing processes On examining the enlarged image through a screen by a stereopticon an immense amount of elaborate detail appeared, several of the canals being plainly in evidence As these photographs were taken a month or so before Mars had reached its nearest to our planet, we may look forward with interest to those which will be obtained on the date of nearest approach

Abstracts from Current Periodicals

Phases of Science as Other Editors See Them

Family Likeness in Handwriting

SOME of our readers may have amused themselves with the hobby of reading character from a person's handwriting. The indications thus obtained may perhaps also be applied for serious purposes. If a person's writing discloses his character, and if individuals of the same family resemble one another in their characters, we must expect to find that there will be a resemblance shown in their handwriting also. That this is indeed the case is shown very clearly in a number of examples illustrated by R. H. Chandler in *Knowledge* and reproduced here. Perhaps the most striking case of general resemblance is the handwriting of two sisters which is reproduced in Fig. 1. Note especially the formation of the word "the," which

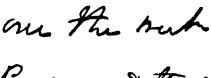


Fig. 1.—Handwriting of two sisters.

is almost identical in the two cases. Somewhat similar remarks might be applied to the cases shown in Figs. 2 and 3, while the resemblance of the characters

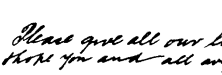


Fig. 2.—Three brothers write very similar hands.

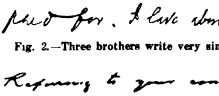


Fig. 3.—The writings of these two brothers are almost undistinguishable.

shown in Fig. 4 is less obvious but is really most striking when we examine into details. Note for example the peculiar method that both father and son follow in lifting their pen in writing the word Belvedere. Each makes an entirely separate act of writing the "e" in the middle of this word. Another feature common to both writings is that the letters increase in size toward the end of each word. This is especially marked in the first example, the father's writing

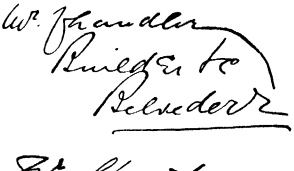


Fig. 4.—Father and son. The resemblance here is in details rather than in general form.

Motor Trucks for Mines.

MR. H. M. BEATSON, writing in *The Engineering and Mining Journal*, draws attention to the utility of automobile ore trucks at mines where ore is hauled by wagon to mill, smeltery or railroad shipping station: "There should be a demand for such trucks just as soon as wagons suitable for hauling ore are placed on the market. The automobile truck is a comparatively recent development. It is still hardly beyond the experimental stage, but it already gives promise of hauling ore at a smaller cost than such work can be done by teams.

"At some mines traction engines have been used for hauling a string of wagons. Where the roads were comparatively level and in good condition, they proved to be satisfactory, but the traction engine is too heavy in proportion to its tractive power to do the work that could be expected from the lighter gasoline-motor truck. The traction engine sinks deeply into soft ground, cannot readily run on steep grades, and is too heavy to safely cross the wooden bridges that are so frequently used to carry a road across a stream. The motor truck is free from most of these defects, but in order to pull a number of wagons in one train some special provision will have to be made to control the trailers on steep grades.

"This has been the object in view of a German manufacturing company that has recently built a road train in which the lightness of the gas-motor truck is combined with the advantages of a traction engine for pulling a number of wagons. The train consists of a generator wagon and six trailing motor wagons, each of which is capable of transporting five tons at a speed of seven to ten miles per hour. The two gasoline motors drive two electric generators. For each axle of all the wagons there is one driving motor. Steering is effected from the driver's wagon, and the provision of suitable shafting between the trailers causes them to follow the bends or curves in the road taken by the generating wagon.

"*It is said that these trains can travel readily over* rough ground, that the wheels, which are fitted with broad tires do not sink into sandy soil. The weight is better distributed and is less than that of a traction engine of equal power."

The Workman's Attitude Toward the Machine

IN a recent number of *Die Umschau*, under the heading "What the Workman Thinks of the Machine," F. Müller gives an account of impressions gathered by him regarding the place which machinery occupies in the mind and life of the workman. The method which the author has adopted to obtain his material is to approach a large number of workmen, requesting them to express their views to him by letter. He quotes passages from a number of such letters, from which a few excerpts are given below.

An umbrella maker writes: "For the last twenty-two years I have had my post at a special machine for making umbrella ribs. There are hundreds of members and joints working at a time. The eye finds it quite impossible to follow all the motions. The first impression which the machine made upon me was one of admiration, coupled with a certain dread. I believe man would be better off if there were not so many machines in use. My machine can hardly be said to be dangerous, unless a man commits some act of extreme negligence. In such case it is true that I have known one of my own fellow workers to have his hand crushed into a shapeless mass. I shall never forget the sight. Such accidents harden a man and seem to turn him into a machine himself."

Another writes: "If an accident has occurred in the works, it often affects a workman in such a way that he becomes extremely nervous and excitable. At every chance outcry, made perhaps in jest by some one of his fellows, he imagines that some one has been caught in the machine. The accident will torture such a man in his sleep, from which he will wake up with a start in the grip of a horrible nightmare."

A glass maker in Düsseldorf, who has been at his work for thirty-two years, makes the following thoughtful observation: "I am of the opinion that a man attending a machine cannot follow up an idealistic train of thought, but becomes deadened in his sensibilities. On the contrary, in the pursuit of some congenial manual labor, such as glass making was until recently, he has an opportunity to do this. There is a peculiar charm in watching a gang of men working at the tank furnace and singing at their work. It seems a pity that the machine should put an end to all this. In the machine room there is always a certain depression. My opinion is, living for a prolonged period with the machine means a [illegible] drying of a man's higher instincts."

Another workman remarks: "It is found that machine attendants are much more irritable and more easily given to anger than manual laborers."

This complaint of the strain upon the nerves, the ill effect upon the man's temperament, occurs almost all the letters published by the author; is too, is found the statement that the workman's is disturbed by evil dreams about accidents. says: "I believe that we should be much without the machines, and that there would quarters less cripples in our population than present conditions." This statement may, perhaps thought exaggerated, and is here quoted for what is worth. Nevertheless, it evidently represents a *mon impression among workmen, for close upon it we* find an observation by another workman, who says that "of four hundred and fifty machinists on wood-working machines in Munich, there are not ten who still possess their ten fingers."

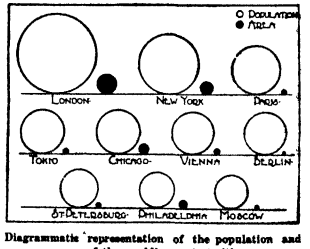
While it appears probable that the workmen's mates may in some cases be exaggerated, through natural horror at some of the terrible accidents witnessed by them, the mere fact that this impression exists is sufficient to command our very thoughtful and sympathetic attention.

The Great Cities

SOME interesting facts relating to the population statistics of the world's great cities are cited by Prof. W. B. Bailey in the *Independent*:

There are at present ten cities in the world with a population of over 1,000,000. Of these, three are in the United States. Russia is the only other country to have more than one city of this size.

London leads with a population of over 7,000,000; but its area is over 440,000 acres. The area of Greater New York is less than half that of London. If New York city could annex enough of its suburbs to make its area equal to that of London, it would at present have a population of over 6,000,000. Even without annexing any more territory, New York may, within twenty years, become the greatest city in the world. If it were possible to include suburbs, as has been done by London, it might become the leader within ten years. The area of Registration London, not including the outer ring, is 74,839 acres. On this territory is found a population of nearly 5,000,000, but within the past decade the population of the old city of London has actually decreased. Business is crowding residences from the center.



Diagrammatic representation of the population and area of the world's greatest cities.

Berlin has recently annexed suburbs with a population of nearly 1,000,000. It seems likely that when figures are available it will be discovered that Berlin has displaced Paris as the third city in the world. The following are the population and area of the ten largest cities in the world at the latest date for which figures are available:

City.	Area in Acres.	Population.
London	441,600	7,252,983
New York	209,313	4,766,883
Paris	19,280	2,763,393
Tokio	27,982	2,186,079
Chicago	117,447	2,185,283
Vienna	39,686	2,085,539
Berlin	15,698	2,070,695
St. Petersburg	22,991	1,876,000
Philadelphia	81,328	1,549,008
Moscow	17,054	1,359,254

Suggestions for the Workshop

Ingenious Expedients of Resourceful Mechanics

A Secret Lock for a Cabinet Door

By William J. Horner

THE method of locking shown in the illustrations is suitable for secret doors or panels which are not supposed to open, or it may be used on hinged cupboard or cabinet doors in addition to or in the absence of an ordinary lock. The principle is that of an inside latch or bolt operated by a knife blade, or similar thin instrument, put through a crack between the door and its framework. If a crack for this purpose is undesirable it would be easy with a little ingenuity to work the bolts by a string or wire carried to a convenient point away from the door. Although the method of operating the lock may give the idea that it is an insecure and weak fastening, it actually may be very strong indeed, for the strength of a lock

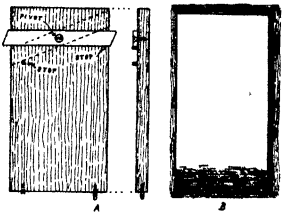


Fig. 1.—Panel with swivel cross bar.

does not depend on the size or character of the key which opens it.

Fig 1 shows a panel or cover and the opening into which it fits. A swiveling cross bar is pivoted to the inside face of the panel. When in the horizontal position the ends of the bar project and fit either behind adjoining panels or into slots, and the panel is locked in place. When the bar is swung into the position shown by the dotted lines its ends are flush with the edges of the panel. Stops are inserted as shown to permit only just the amount of swing required. The lower end of the panel has fixed pins or dowels to secure it, or the wood may be tongued or rebated. Screws with their heads filed off make good pins. Shoulders are necessary in the opening to prevent the panel from being forced inwards, and when it is locked it should be tight. If desirable nail heads

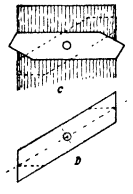


Fig. 2.—Modified form of cross bar.



Fig. 3.—Door with short fastenings.

may be driven in at each end to give it the appearance of being nailed in place.

The cross bar shown in Fig 2 is a neater shape than the simpler form in Fig 1. Its ends are cut so that the points are central instead of being at opposite edges of the bar. Besides this it will be seen in the dotted position that the portion cut from the highest part gives a horizontal edge which can be set to just clear the shoulder against which the panel beds and so the center of the bar can be slightly nearer the end of the panel. The way the bar is marked out is apparent at *D*. It may be of wood or metal.

So far the examples show bars running across the panel and securing it on both sides. Fig. 3 shows a hinged door with short fastenings at the side which opens. They are pivoted midway of their length so that they will balance. The dotted vertical pieces which cross them are guides which act both as stops and relieve the central screw from strain if an attempt is made to pry the door open.

Unless the panel is very narrow these would be necessary in Figs. 1 and 2. The stops shown in Fig 1 are suitable where little strength is required but if the panel is forced outward the bar, secured only at

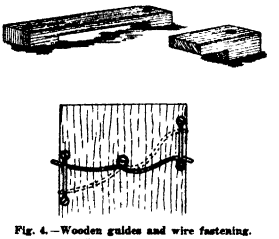


Fig. 4.—Wooden guides and wire fastening.

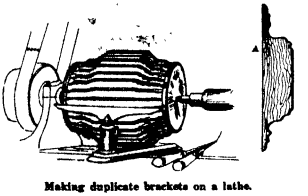
the center, may break or bend and the screw be loosened. Combined guides and stops, as shown in Fig 4, screwed to the door close to the edge, prevent this and greatly strengthen the fastening. The double-ended guide in Fig 4 stops the bar in each direction and keeps it close to the door surface. The single one is intended for use where there is not room for the longer one. It would be suitable for stopping against the lower edges of the bars in Figs 1 and 2, at the right-hand sides, where, in the dotted position, there is no room above the bar for attaching a double stop and guide.

Fig. 4 also shows a fastening on the same principle made of wire instead of wood. The wire is bent to a curve so that its ends project nearly at right angles in all positions of its travel. If it was straight and consequently at right angles in one position and sloping in the other a knife would not work it so easily. Moreover when bent its extension can be adjusted exactly as required by further bending.

Turning Duplicate Forms

By Albert F. Bishop

A WOODWORKING firm received an order for several hundred brackets which naturally would be sawed on the jig saw. The party ordering the brackets stated that they must be perfectly smooth on the sawed edges. The sawyer knew at once that if each piece was sandpapered by hand on the edges, the extra time required would greatly delay the work. His fellow workman, a wood turner, said he could make the pieces in a lathe. This is how he did it. He took a log of wood for a hub, and with a wobble saw cut longitudinal grooves in it to receive the



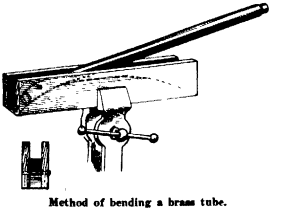
Making duplicate brackets on a lathe.

bracket pieces. These were previously cut a trifle long, leaving a little tip on each end to be clamped by the iron bands that were put on each end of the hub. The whole thing was placed in the wood lathe and turned by hand like the pattern marked *A*. The sandpapering and polishing came next, which made the forms absolutely smooth and gave them a nice finish. In doing work by this method care was taken to fit the pieces nicely so as to prevent chattering and slivering on the sides.

Bending a Brass Tube

By A. F. Clark

IN the issue of May 6th is described a process for bending brass tubing. The following is a much simpler method where a coil spring long enough and of the proper size is not available. Plug one end of the tube with a piece of wood and then stand it on end and fill it with dry sand. Tamp the sand firmly by striking the plugged end on a block of wood. When the tube is full plug the other end also with wood, then take a piece of hard wood as thick as the outside diameter of tube and saw it to the shape you wish to bend the tube; then nail two other pieces of wood,

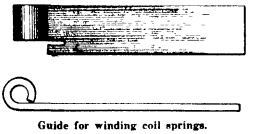


Method of bending a brass tube.

one on either side of the form. Clamp the whole firmly in a vise as shown in the sketch. Then drive a nail through the two outer pieces near one end of the form under which insert the end of the tube, after placing a small piece of flat iron or a chisel between the nail and the tube. The two outside pieces are necessary as all tubing has a tendency to flatten while being bent. After the tube is bent the wooden plugs can be easily removed by inserting a wood screw into them and, after warming the end of the tube, using the screw as a handle to pull out.

Guide for Winding Coil Springs

THE accompanying illustration shows a small tool which will be found useful for winding coil springs in a lathe. It is made of a piece of three-sixteenth inch sheet steel, one end of which is turned over to fit the arbor on which the spring is to be wound. A slot is cut in the tool near the arbor bearing, to serve as a



Guide for winding coil springs.

guide while winding the spring. The tool is placed on the arbor and the latter is centered in the lathe. One end of the wire is fastened in a hole drilled in the arbor and then, by passing the wire through the slot, it will be guided as the arbor is turned to make a uniform spring.

Grinding Copper.—When it is desired to grind copper on a carborundum wheel the copper invariably clogs. By rubbing on tallow this is prevented and apparently the tallow does not interfere with the cutting of the wheel.—B. F.

Knife Made from a Hacksaw Blade

By H. M. Nichols

THE steel used in hacksaw blades is well adapted for making knives, as it can be ground to a good keen edge that stands up well under usage.

The knife shown in the illustration was made from a hack saw blade ¾ inch wide and about 1/16 inch thick. The blade part was ground off on an angle, as shown, and the handle was formed by bending a piece of sheet zinc in the form of a U over the back of the blade. Of course a more pretentious handle



Hacksaw knife.

could be made from wood, held in place with rivets, but the handle described answers the purpose very well and has the merit of being made quickly. The blade is ground like an ordinary knife blade, or it can be ground on one side only like a chisel. If used for a scratch knife the latter method of grinding is preferred by the writer.

The First National Mine-Safety Demonstration

Study of a Real Mine Explosion

By Charles L. Wright, Fuel Engineer, Bureau of Mines

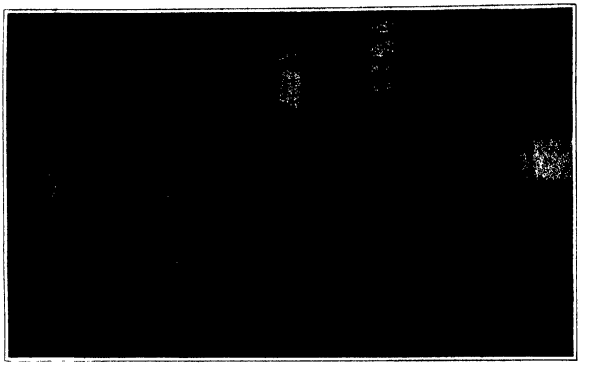
THE work that is being done by the Government to reduce the dangers of mining was brought out strikingly in the First National Mine Safety Demonstration which occurred at Pittsburgh, Pa., on October 30th and 31st, under the auspices of the United States Bureau of Mines with the assistance of the American National Red Cross Society and the Pittsburgh Coal Operators' Association

The work of the explosive testing section was exhibited in a spectacular manner in the gas and dust gallery which is a steel tube 100 feet long and 6½ feet in diameter open at one end and closed at the other, with the exception of a small hole through which it is fired by the flame from a small cannon charged with the explosive that is being tested The gallery is provided with explosion doors on top which are raised by the force of the explosion, and windows of heavy glass on the sides through which flame is visible when an explosion of gas or dust is produced A portion of the tube was partitioned off by heavy paper making a chamber in which gas and air were mixed so that the mixture contained seven per cent of methane and ethane, both explosive gases A charge of black blasting powder equal in strength to one-half pound of forty per cent nitro-glycerine dynamite was fired into the gallery igniting the gas and producing a terrific explosion Again, an amount of permissible explosive equal in strength to the black blasting powder was fired in a gaseous mixture of the same composition As no explosion of the gas took place, the relative safety of black blasting powder and permissible explosive was evident This test of explosives is especially valuable in gaseous mines where there is the liability that the flame from the explosive may ignite pockets of gas which may be present near where coal is being blasted out

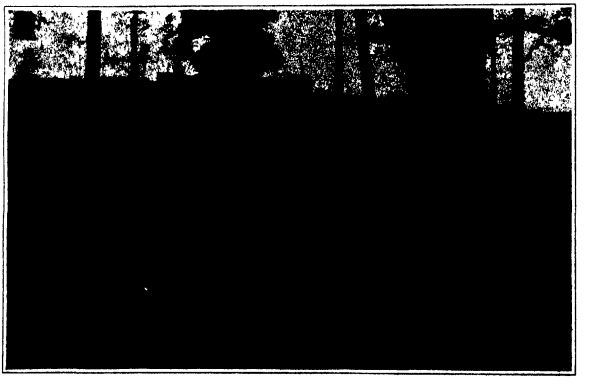
In another building lighted by incandescent lamps were broken in an explosive mixture of gas and air illustrating the relative safety of lamps of different candle power when operated with different voltages In still another building a foundry cupola was in operation to show the method of taking gas samples and temperatures in various zones of the coke bed for the purpose of studying the fundamental principles of the process with a view to possible improvement A gas producer was in operation burning fuel at a high temperature and capacity and in which the ash and clinker were removed by tapping off the liquid slag at stated intervals

In the fuel briquetting plant two types of briquetting presses were in operation one of which was producing briquets from California lignite under a pressure of 20,000 pounds to the square inch without the use of artificial binder while the other machine made briquets of ordinary bituminous slack using six per cent of water-gas pitch as a binder These briquetting experiments have for their object the better utilization of fuel waste and low grade fuels

The long combustion chamber of the bureau was also interesting to many of the visitors This is essentially a Murphy stoker at one end of a long chamber built of brick and lined with fire brick at the other end of which is a water tube boiler At several points on this chamber there are openings for the insertion of thermo-couples and the withdrawal of samples of flue gas A large number of gas samples are taken from the various points simultaneously and the study of the analyses of these samples makes it possible to determine the proper distance that the furnace should be from the cold boiler tubes in order that complete combustion may take place This distance varies with different types of fuels and the results of these investigations will undoubtedly furnish valuable data for designers of boilers and furnaces



Long combustion chamber, showing apparatus for testing samples of gases at various points.



Entrance of the mine after the explosion. Note the debris.

THE FIRST NATIONAL MINE-SAFETY DEMONSTRATION

Another feature of the demonstration was a safety lamp test Single and double gauze safety lamps were placed in a testing apparatus where they were subjected to currents of air of a known velocity containing eight per cent of methane and ethane The lamps which were safe to use did not produce an explosion of this mixture of gas and air; others did, and thus their relative safety was demonstrated

Men in various types of breathing apparatus were exercising in a room filled with a noxious atmosphere and a glass partition permitted the visitors to see in a graphic manner how operations are carried on by the rescue corps under conditions similar to those existing after an explosion has occurred in a mine.

There was also an exhibition of apparatus for the physical testing of explosives including a ballistic pendulum by means of which the relative disruptive forces of an explosive is determined; a pressure gage for determining the pressure developed by a known weight of an explosive; a calorimeter for determining the heat of combustion of an explosive; a flame testing apparatus for the determination of length and duration of the flame of an explosive, an apparatus for determining the rate of detonation of an explosive, a large and small impact machine for determining the force necessary to set off explosives, Trauzl and lead blocks which are also used for determining the relative power of an explosive and a cone and pendulum friction device for determining the behavior of explosives under friction

The explosibility of coal dust was shown by means of a laboratory coal dust ignition apparatus consisting of a heavy glass vessel into the bottom of which coal dust was blown by air upon a wire heated red hot by an electric current The force of the explosion of the coal was graphically shown by the bursting of a thin glass flask connected to the top of the ignition apparatus

In gas and dust gallery No 2 an inclosed electric mine motor was shown operating in an explosive mixture of gas and air without producing an explosion Later the protecting devices were removed from this motor and an explosion of the gaseous mixture resulted The relative safety of motors for mining purposes under the two conditions open and protected were thus demonstrated

Two of the mine rescue cars of the Bureau were on the siding at the plant and open for the inspection of visitors

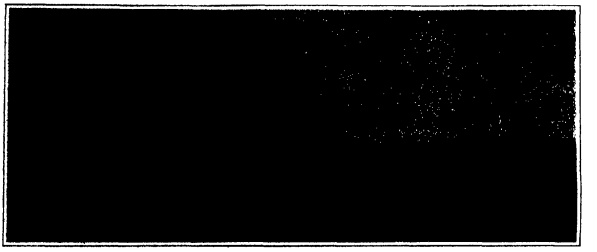
In the afternoon of the first day the experimental mine of the bureau was visited by a party of about two thousand people, a special train being provided The trip to the experimental mine was made for the purpose of seeing a demonstration of the explosibility of coal dust in a real mine. The mine is located in Bruceton, Pa., in the Pittsburgh seam of coal which at this point outcrops on the side of a hill about 100 feet above the railroad The mine was opened primarily in order to study the principles involved in dust and gas explosions and to test various methods of preventing and checking explosions in progress under actual mine conditions When the special train arrived at the station the rain was falling steadily, but this was not sufficient to dampen the ardor of the enthusiastic visitors including several ladies As soon as the party had climbed the steep ascent from the railroad to the mine they were invited to walk through the mine and 1,131 persons by actual count availed themselves of this opportunity. When all of the party were out of the mine again they were requested to take positions about twenty-five yards up the hillside above the mine

...t the explosion. Between 600 and 700 pounds of coal dust had been scattered along 600 feet of the main entry which is 750 feet long and two pounds of black powder were placed in a drill hole at the extreme inner end of the main entry in such a manner that the conditions would represent those similar to a blown-out shot in actual mining. Electric wires connected this charge of explosive with the instrument house outside of the mine The wires were placed in circuit with a source of electric current and the powder explosion which followed ignited the coal dust in the mine resulting in a terrific explosion It was dark by the time that the explosion occurred and the smoke and flame mounted high into the air above the entrances to the mine The air was filled with pieces of stone, broken concrete and wood and the people involuntarily took refuge under the trees There was no real danger, however, as the people were above and back of the mine entrances. The force of the explosion was manifested in the vicinity of the mine by the damage done Near the main entry a loaded mine car had been shot back about fifty feet while another partly loaded had been blown more than one hundred yards over a bank into the valley. The big bags of sand which were used in the brattices 130 feet from the entry had been blown out into the open The temporary fan house had been wrecked and the office building partly demolished If any of the mining men present had any doubt as to the explosibility of coal dust in a mine without the presence of gas, this question was settled once and for all

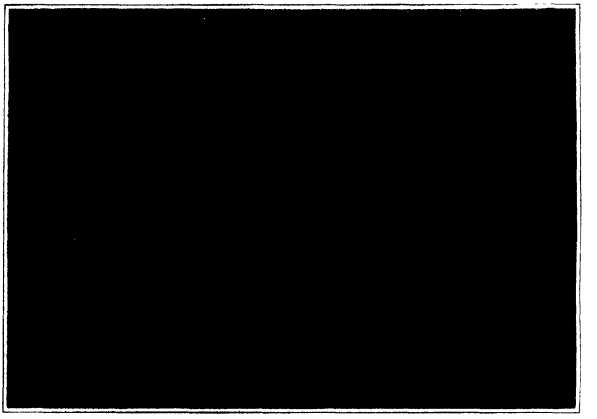
It had been planned to have men equipped with oxygen helmets enter the mine immediately after the explosion to take gas samples, extinguish incipient fires and inspect the condition of the roof, but the lateness of the hour made it necessary for all to hasten to the train waiting to convey them back to Pittsburgh

Every one who saw this demonstration was profoundly impressed with the importance of the test and many compliments were given to Director Holmes and those in charge of the experiment.

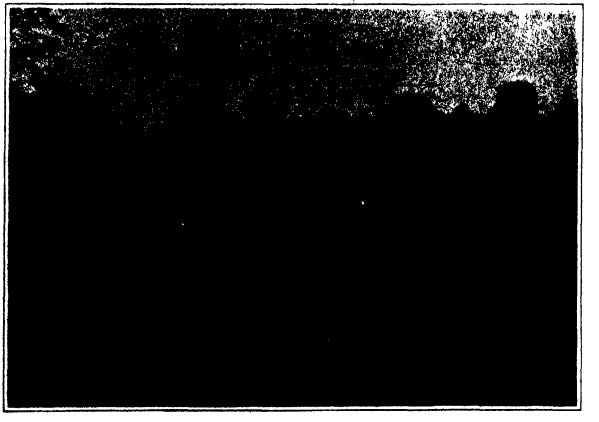
On the morning of the 31st the great first-aid meet and mine safety demonstration was held at Forbes Field. The first thing on the program was the first-aid exhibition. The forty teams that participated were arranged in a row facing the seats. While many of the teams participating came from Pennsylvania and adjoining States, there were others which came from longer distances notably those from Tacoma, Washington, Dawson, and New Mexico. The teams performed alternately in two sections, the even numbered teams working the same problems while the odd numbered teams worked other problems. The first-aid problems performed included treatment of lacerated wounds on the head and body, the treatment of fractured bones and dislocated joints, the removal of a man from an electric wire and the treatment of gas and electrical burns



A coal dust explosion in the gallery at Forbes.



Helmet man entering the gallery after the explosion.



Rescue squad bearing an injured man.

THE FIRST NATIONAL MINE-SAFETY DEMONSTRATION.

Following the first-aid work a demonstration of the behavior of a permissible explosive in the presence of coal dust was made in a temporary steel gallery or cylinder 133 feet long and 8 feet 4 inches in diameter The amount of explosive used was equal in disruptive force to one-half pound of forty per cent nitro-glycerine dynamite The explosive was fired into the gallery from a cannon through a small opening in the steel end of the former The other end was open to the atmosphere One hundred and thirty-three pounds of coal dust was distributed uniformly throughout the explosion gallery and twenty pounds of dust was placed on a wooden bench twenty feet long near the mouth of the cannon making a total of 153 pounds of coal dust When all was ready the charge was fired from a distance through wires by means of a storage battery No explosion of the coal dust was produced by this test which demonstrated the safety of using a permissible explosive in the presence of dust A second demonstration was made in the same gallery with the same amount of coal dust using a charge of FFF black blasting powder equal in disruptive force to the permissible explosive used in the previous test When this black blasting powder was ignited from a distance a tremendous explosion took place, the flame escaped from the safety doors on top of the cylinder and great clouds of dust and smoke were blown out of the end of the gallery

Immediately following this explosion while the gases within the gallery were still unbreathable a rescue party of foremen miners of the Bureau of Mines aided by squads from some of the visiting first-aid teams and all of them equipped with various types of breathing apparatus, entered the gallery and recovered several supposed victims of the mine explosion bringing them from the explosion gallery and placing them in the care of squads of foremen miners and first-aid miners of the Bureau of Mines who demonstrated the various first-aid problems using the pocket first-aid packet only and such things as might be handy in a mine after an explosion

Another interesting feature of the exhibition was the mine gas test made with the use of birds in exploring mines after explosions or mine fires at which carbon monoxide causes a large percentage of fatalities Birds are much more sensitive to the effects of this poisonous gas (carbon monoxide), than human beings, and when birds taken with a rescue party into a mine show signs of distress the party (which of course is supposed to be without oxygen helmets) will ordinarily have time to retreat to safety At Forbes Field the practicability of this test was demonstrated by a gas chemist of the bureau who entered a glass box about 2 feet wide by 5 feet long, and 6 feet high with canaries in cages The atmosphere of the box contained one quarter of one per cent of carbon monoxide gas (the miner's white damp). In eight minutes three of the birds were overcome and collapsed completely

The Heavens in December, 1911

By Henry Norris Russell, Ph.D.

WE had occasion not long ago to speak of the interesting observation of Prof Stebbins of the University of Illinois, who devotes his time to making very accurate measures of the brightness of the stars, with an apparatus depending upon the change in the electrical resistance of selenium when light falls on it Not content with the study of known variable stars, Prof Stebbins has taken up the work of discovery, with conspicuous success, finding two new variables in the first two stars observed.

As, on the average, perhaps one star in a hundred, at most, varies in brightness, some principle must have guided such a successful search

Spectroscopic observation tells us that many bright stars are really close doubles, far too near together to be separated by the most powerful telescopes, but revealed by the approach or recession of the star as it swings in its orbit about the center of gravity of itself and a companion

In a few cases, such as Algol, the faint and relatively dark companion comes in front of the brighter star at every revolution and eclipses most of its light, causing conspicuous changes of its apparent brightness

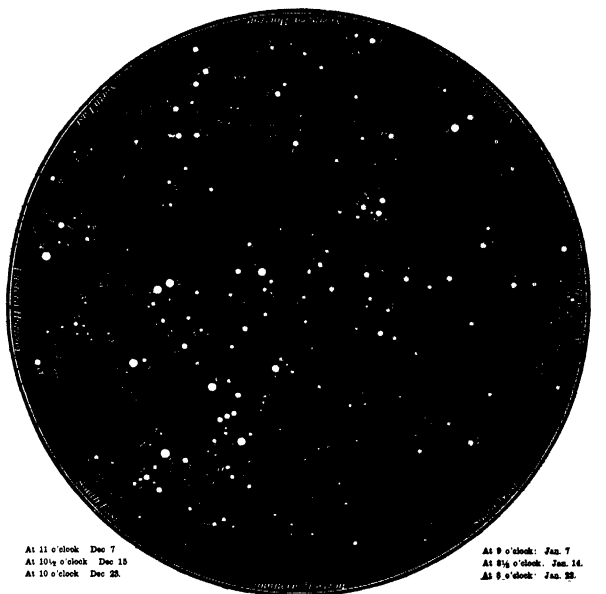
The amount of light variation in such a case obviously depends on the character of the eclipse If the companion passes almost squarely in front of the primary, it will eclipse the greater part of its area, and, indeed, may completely hide it if, as often happens, the former star is the larger But if it passes apparently to one side of the brighter star and, even at most, covers up but a small portion of the latter, only a little light will be lost by the eclipse, and the apparent variation will be small, and can be detected only by very accurate measures

Observing the brightness of selected spectroscopic binaries of this sort, Prof Stebbins has found that the bright stars Beta Aurigæ and Delta Orionis are eclipsing variables of the type just described He defers full discussion of the latter until more observations have been secured, but his conclusions regarding the former are presented in definite form

Beta Aurigæ was one of the first spectroscopic binaries discovered Careful study by several observers has shown that the system consists of two stars of very nearly equal mass and brightness, revolving at equal distances on opposite sides of their common center of gravity, in a circular orbit, within a period of about an hour less than four days Prof Stebbins finds that, just at the times when, according to the spectroscopic data, either star ought to be in front of the other, the apparent brightness of the system diminishes by about 7 per cent This shows that a partial eclipse takes place, one star covering up about one-seventh of the other, cutting off that fraction of its length, and hence one-fourteenth of the total light of the pair These eclipses last a little less than six hours

Between the eclipses the brightness of the star is not perfectly constant, but increases by about 1 per cent until the time halfway between eclipses, and then falls again to its original value, just before the next eclipse This may be explained by assuming that the mutual attraction of the two stars causes them to be slightly elongated toward one another, like two eggs with their narrow ends pointing at each other! When the stars are just out of eclipse, we see them end on

A day later, midway between eclipses, they are broadside on, and look correspondingly brighter. The amount of this elongation is, however, only 1 per cent of the whole diameter, which could hardly be detected on a drawing to scale From the length and depth of the eclipses, it is possible to find the inclination of the orbit plane, and the diameters of the two stars, in terms of that of the orbit The spectroscopic observations then furnish us with a reliable scale of miles, and enable us to calculate the actual dimensions and mass of the system. What is more, in this case the parallax of the star is fairly well determined, both by direct measures and because it belongs to the group of stars moving together in space, of which the principal stars in Ursa Major are members. He can, therefore, compute the actual brightness of the stars, compared with the sun



NIGHT SKY: DECEMBER AND JANUARY

Combining all these facts, we reach a knowledge of the system more extensive than we at present possess for any other star We may summarize it as follows.

Beta Aurigæ consists of a pair of stars of equal size and brightness and very nearly equal mass, which revolve about their common center of growth in circular orbits lying in a plane inclined 12 degrees 49 minutes to the line of sight, with a period of 3 days 23 hours 2 minutes and 30 seconds, and mutually eclipse one another at every revolution. The two stars are elongated toward one another by their mutual attraction to the extent of 1 per cent of their diameters, and, owing to the influence of the tides raised by each on the other, the period of revolution is increasing by seven-eighths of a second every year.

The actual distance between the centers of the two stars is 7,630,000 miles, and each star is 2,200,000 miles in diameter The more massive component has 2.38 times the mass of our sun, and the other 2.34 times.

The whole system is at a distance of about ten million times that of the sun—so great that light takes 160 years to travel over it Each of the two stars gives out about 130 times as much light as our sun, from a superficial area a little less than seven times as great, so that per square mile, these stars send out nearly twenty times as much light as does the sun

The sun itself, if in front of one of them, would appear as a rather small and very dark spot on the star's surface.

Though there is no other individual star about which we know nearly as much as this, it is probable, from various lines of evidence, that Beta Aurigæ is a fairly good representative of a considerable class of the brighter stars—which emphasizes the fact that our mighty sun is, after all, one of the smaller members of the host of heaven.

The Heavens.

Turning our gaze overhead, we find Auriga close to the zenith. The brilliant Capella may serve as our landmark. Beta Aurigæ is close by on the east, almost in the line toward Castor and Pollux, which are conspicuous at an altitude of about 45 degrees. Procyon shines on the right, lower down, and Regulus, with the Sickle of Leo, is rising a little north of east.

In the southeast is the magnificent group of constellations centering in Orion Sirius, still lower down, but surpassing all other stars in brilliancy, so outshines the other stars of Canis Minor that it is only when we hide him from view that we realize that some of them are as bright as the stars of Orion's belt High up near the zenith is Taurus, now made conspicuous by the ruddy Mars, which exceeds even Sirius in brilliancy.

The constellation of the Hare and the Dove, below Orion, though small, contains more stars of fair brightness than does the vast extent of the sky to the westward, occupied by the winding course of Eridanus. Cetus, farther to the right, is more conspicuous

Due west from the zenith we find Perseus, then Andromeda, and finally Pegasus Between these last and Cetus are the little triangle of Aries and the extensive but inconspicuous constellation Pisces

This is the faintest of the zodiacal constellations, except perhaps Cancer, but makes up for this by some faint resemblance to the two fishes bound together by a cord, which are its traditional likeness.

This cord, or rather cords, start at Alpha Piscium, a fairly conspicuous star of the fourth magnitude, pointed out by a line from α and through γ Ceti. From this one line of faint stars runs northward toward β Andromedæ to the Northern Fish, which is represented by a group of faint stars south of β Andromedæ Another and rather more conspicuous line of stars runs west from α Piscem for about 30 degrees to the Southern Fish, whose body is marked by an irregular polygon of small stars south of the great square of Pegasus Our initial letter shows the general arrangement of the constellation.

In the northern sky) Cassiopeia and Cepheus are on the left of the Pole, Ursa Minor and Draco below, and Ursa Major coming up on the right

The Planets.

Mercury is evening star until the 25th, and afterward morning star. He is apparently farthest from the sun on the 7th, but, being very far south, is unfavorably placed, and sets about 5:40 P. M.

Venus is morning star, very conspicuous and brilliant, rising about 3:10 A. M. on the 1st, and 4 A. M. on the 31st She passes eastward and southward from Virgo almost into Scorpio during the month, and, telescopically, appears like the Moon two days past the first quarter. Mars is in Taurus, just past opposition.

(Continued on page 506.)

The Inventor's Department

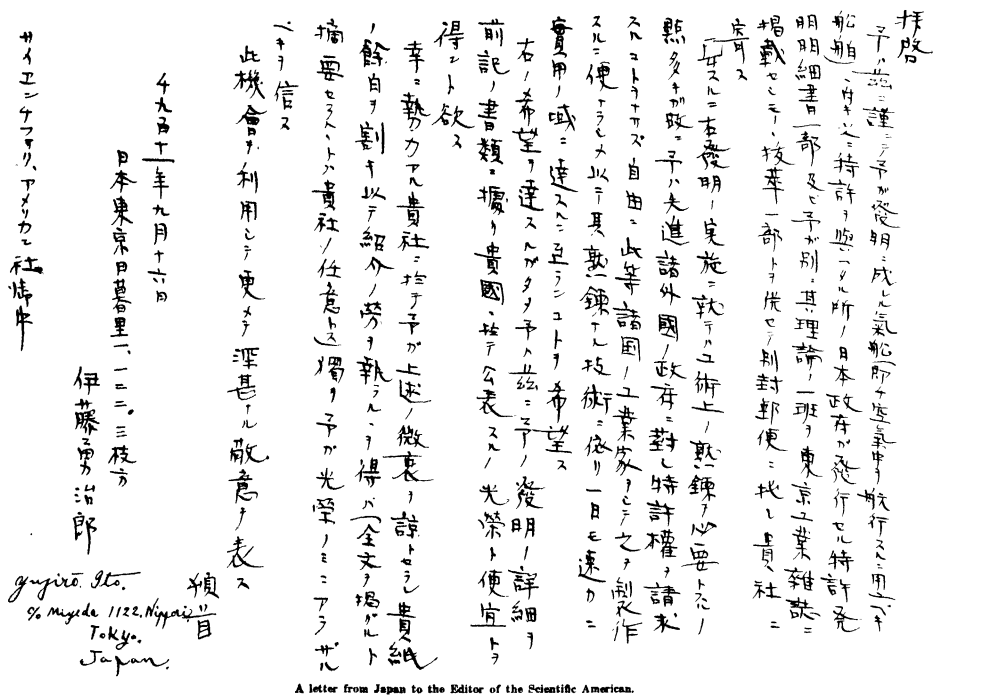
Simple Patent Law; Patent Office News; Inventions New and Interesting

A Letter from Japan.

THERE is scarcely a nook from the Straits of Magellan to Alaska, and from Siberia to the Cape of Good Hope, that is not reached by the SCIENTIFIC AMERICAN. Hence it follows that the Editor's mail includes letters from all quarters of the earth. The questions asked him run from the classic problem of the hare and the hunter to the request for a formula for trisecting an angle. As a rule, these letters are written in English or in one of the familiar European languages. Occasionally the Editor is puzzled by a letter written in characters which are beyond his use with their expert technique, without delay.

"In order to fulfill my desire, I wish to have the honor and facility of having the details of my invention made public in your country by the papers I am submitting you. I shall feel greatly honored if your esteemed firm gives consideration in this matter and has the kindness to introduce my invention in your valued magazine. I will leave it entirely to your own convenience whether you use the full text or its outline. With great respect, I remain, Very truly yours,

"YUJIRO ITI."



A letter from Japan to the Editor of the Scientific American.

ken. Only the other day a communication was received from Japan, which is reproduced herewith for the benefit of those who may prefer to read it in the original. Needless to say, the Editor had to ask a Japanese friend for the following translation:

"THE SCIENTIFIC AMERICAN:

"Dear Sirs: I am sending you under separate cover, a copy of patent specification published by the Japanese Government, for an airship invented by myself and for which patent was awarded, also a cutting from *Tokyo Kogyo Zasshi* (*Tokyo Industrial Magazine*) to which I had contributed a portion of the theory.

"As a matter of fact, technical skill is necessary in the practical application of this invention, therefore, I am not going to secure patents from the governments of progressive foreign countries, but my desire is to facilitate the manufacturers of those countries in manufacturing my invention and in putting it into practical

The Japanese patent referred to is in the Editor's drawer, and he will be glad to show it to any one who thinks he can make use of the invention.

The Original Organic Patent Act

THAT our forefathers realized the importance of inventions and appreciated the part they would play in the development of our material resources, is shown by the serious attention paid, in framing the constitution, to the patent and copyright clause and the early enactment of the organic patent act of April 10th, 1790, by the Congress. The Departmental proceedings under this act, looking to the grant of patents, is interestingly told in the following extract from the *Patent Official Gazette* of October 9th, 1877:

By act of April 10th, 1790, the first American patent system was founded. Thomas Jefferson inspired it, and may be said to have been the father of the American Patent Office. He took great pride in it, it is said, and gave personal consideration to every application that was made for a patent during the years between 1790 and 1793, while the power of revision and rejection granted by that act remained in force. It is related that the granting of a patent was held to be in these early times a weighty event in the history of the State Department, where the clerical part of the work was then performed.

It is a matter of tradition, handed down to us from generation to generation by those who love to speak of Mr Jefferson and his virtues and eccentricities, that when an application for a patent was made under the first act, he would summon Mr Henry Knox, of Massachusetts, who was Secretary of War, and Mr Edmund Randolph, of Virginia, who was Attorney-General, these officials being designated by the act, with the Secretary of State, a tribunal to examine and grant patents; and that these three distinguished officials would examine the application critically, scrutinizing each point of the specification and claims carefully and rigorously. The result of this examination was that during the first year a majority of the applications failed to pass the ordeal, and only three patents were granted. In those days every step in the issuing of a patent was taken with great care and caution, Mr Jefferson seeking always to impress upon the minds of his officers and the public that the granting of a patent was a matter of no ordinary importance. During 1791, thirty-three patents were granted, in 1792 eleven, and in 1793 twenty, making sixty-seven under the first statute.

New Roof for Patent Office Building

THE Patent Office has just been supplied, at a cost of something like four thousand dollars, with a new roof of slag replacing one that has served as a covering for the building ever since the great fire of 1877. It is interesting to compare the difference in cost between the new roof and the old. The one just removed was of sheet copper, but was found to be fairly riddled with holes and cracks from exposure to the elements for more than thirty years. The copper roof cost in the neigh-

Emery Disappearing Carriage

IN the 21st report (October 31st, 1911) of the Board of Ordnance and Fortification to the Secretary of War, we find a reference to the Emery disappearing car-

riage In the report the Board says "There have been no developments, so far as the Board is informed, in connection with the Emery gun carriage, and the board can only repeat what has been said heretofore in regard to the history of this carriage All the work on the Emery design has been done under direct legislative enactment, and the only part to be taken by the Board in the matter is that, when completed, if ever, the carriage is to be tested under its supervision" The report goes on to refer to the several special acts of Congress, beginning with that of February, 1893, and appropriating $130 000 up to the Act of May 27th, 1908, and concludes its reference to the matter as follows In its last annual report the Board stated that 17 years had elapsed since the construction of a carriage of Emery's design was first authorized This remark may now be varied by saying that 18 years have passed and the government still has nothing to show for the expenditure of 95 per cent of the appropriations except the foundations for the carriage which were put in three years ago in order to enable Mr Emery to obtain an additional $5,000 as provided by the act of 1908, practically the first which required him to do anything in return for money paid him "

According to the report, of the $114,443 02 available for the execution of the present contract with Mr Emery for his carriage, $100,811 51 has been paid him, and the report says

"There may be added to the $114,000 mentioned above the sum of $137,656 98 paid under the first contract, which was canceled by congressional authority, so that the total amount authorized has been a quarter of a million dollars Of this sum there remains to be paid Mr Emery $13,531 51, or slightly more than 5 per cent of the total amount authorized "

The Board includes seven Army officers headed by Leonard Wood, Major General, Chief of Staff, President of the Board and one civilian member, William Warner

Notes for Inventors

A Lamp Dimmer for Motor Cars.—The extremely brilliant and dazzling head lights of motor cars are at times very objectionable and some municipal regulations forbid their use Warren A Greenlaw of Melrose, Mass, provides, in a patent (No 1,005,197) for dimming the lamp by sliding the burner away from the strong focal or reflecting point in front of the reflector To do this, he supports the burner so that it can slide longitudinally and utilizes fluid pressure to move the burner from its normal position This enables the driver of the car to dim his light whenever desired by sliding it out of its focal relation to the reflector

Novel Wrench—In patents No 1,004,561 and No 1,004,562, William Henry Joseph Fitzgerald of Braintree, Mass, shows a wrench in which the shank carrying the fixed jaw is tapered, reducing toward the fixed jaw, the sliding jaw has a tapered shank sliding on the shank of the fixed jaw and a yoke encloses both tapered shanks and can be conveniently set to secure the sliding jaw in any desired adjustment

Lubricating Air Brakes.—Edwin A Emery of St Louis, Mo has patented (No 1,004,000) a lubricating means for fluid pressure brakes in which is provided means for charging the air in the train pipe with a lubricant A pipe connects the exhaust port of the triple valve to the chamber at the non-pressure side of the brake cylinder piston in order to vent the lubricant laden air released from the brake cylinder to the said non-pressure chamber to lubricate such chamber

Novel Initiating Apparatus Some secret societies employ many mechanical aids in connection with their introduction of new members Such a device is shown in patent No. 1,004,857, and presents the appearance of an ordinary platform scale The platform, however, is collapsible and as it falls, operates an alarm mechanism The candidate by moving the scale beam releases locking devices and the platform on which he is standing falls and sounds the alarm The patentee is Ernstus De-Moulin of Greenville, Ill

Preserving Corn With Tar.—To preserve corn in the ear and with the husk on is the purpose of patent (No. 1,004,033) to Benjamin F Johnson of Macclenny, Fla In doing this, he ties the husk beyond the tip end of the ear with twine and then submerges it in pine tar A coating of dust is then applied after which it is plunged into air slaked lime

Advertising Novelty.—Robert Klotz of Chicago, has patented (No 1,004,660) as an advertising novelty, a device including a head having a pivoted jaw and a movable tongue Associated with these is a drawer which can be utilized for any purpose and means are provided so that the movement of the drawer operates the jaw and tongue of the head

New Vulcanizing Process.—John R Gammeter of Akron, Ohio, assignor to B F Goodrich Company, same place, has patented (No 1,004,865) a method of vulcanizing in which the tubing to be vulcanized is inflated and a band is wrapped spirally around the tube, the wrapped portion being simultaneously fed through a vulcanizer at the same rate the band is applied, and unwrapping the band from the vulcanized portion

Fly for a Coat —Ordinarly garment flies are open at the edge Abraham D. Goffin of New Haven, Conn in a patent (No 1,004,869) presents a garment fly which has a closed edge the inner flap of the fly having a button hole formed through it and the same flap has a slot through which the finger may be passed in buttoning and unbuttoning the garment, thus avoiding the necessity of having the fly open at its outer edge

Increasing Relative Amount of Hydrogen in Hydrocarbons –Dr David T Day, the well-known petroleum expert of Washington, D C, has patented (No 1,004,632) an apparatus for treating hydrocarbons in which an intermediate oil chamber connects with one of the vapor chambers and tubes connect the vapor chamber through the oil chamber, the purpose being to produce hydrocarbons containing more hydrogen than before, in proportion to the amount of carbon, and in doing this the hydrogenating tubes are immersed in the body of oil which is being distilled and are heated by the oil to a temperature as high as or greater than that of the distillate vapors, thus utilizing the heat of the oil for superheating the commingled hydrogen and oil vapor and effecting saturation of oil with hydrogen, the saturated vapor passing off to an outlet chamber and thence through a goose neck to the condenser

Legal Notes

Assignment by Trustee in Bankruptcy.—In deciding Ex p Eyton O G, 171, pg 481, the Commissioner of Patents, in denying that portion of the petition which asked that the patent, when granted, be issued to the assignee as requested, said

"To investigate the laws of various foreign countries in order to determine the titles to applications for patents pending in this office filed by foreigners who have subsequently become bankrupt would place an enormous and unnecessary burden upon the office Since it is unquestionably proper to issue the patent in the name of the applicant, this is believed to be the safe rule in such cases In the present instance petitioner has not shown that any hardship would result from following this plan "

In the Hubert case, decided September 11th, 1911, published October 17th, 1911, the Commissioner of Patents held that if an assignment be of record, transferring the entire right, title and interest without any qualifications or reservations, and said instrument contains a request to issue the patent to an assignee, such action will be taken by the office, even if licenses be also of record Also that a patent will not be issued in accordance with the request contained in an alleged assignment which is made subject to any exclusive license.

Conflicting Patent Decisions.—Two interesting decisions, handed down in different districts of the Seventh Circuit, have recently been published. The state of facts in both cases was practically identical, that is infringement of the Claude and Hess patent (No 664,383) and the effect upon this patent of the inventors' English patent, dated June 30th, 1896, which expired by limitation June 30th, 1910 This patent concerns the use of acetone as an absorbent for compressed acetylene and appears practically to dominate the packaging of acetylene in cylinders in this country. The important claims in this patent cover a so-called gas package, while the English patent relates to the process The defendants contended that the two patents were for the same subject-matter and that, under the provisions of Sec 4887 R S, the American patent expired with the English. Judge Kohlsaat decided that they were for the same matter and denied an injunction (See 188 F R 85) Judge Dennison, a few weeks later, held that the two patents were for different subject-matter and that, according to the Leeds & Catlin case, 213 W B 301, the American patent was still in force (see 188 F R 89)

Presumption in Reissue that Law was Complied With.—In the case of the John Kitchen, Jr, Company v Levison (Circuit Court of Appeals, Ninth Circuit, July 3rd, 1911, 188 Fed Rep 638) the Court said, "From the reissuance of the patent it is to be presumed that the law was complied with and the proceedings can only be impeached for fraud," quoting Seymour v. Osborne, 11th Wall 516-543.

Mileage Ticket Decision.—In the case of Rand, McNally & Company, in the Circuit Court of Appeals, Seventh Circuit, January 10th, 1911, rehearing denied April 11th, 1911, the Court held that the Richardson & Langston patent (No. 699,489) for a script book, containing a series of coupons to be detached and exchanged for passage-tickets, the essential feature of which is that the units are expressed in money instead of in miles, as in the ordinary mileage tickets, which adapts them to more convenient use on transportation lines having different rates, disclosed patentable invention, and is valid, also held infringed In this case District Judge Carpenter filed a strong dissenting opinion

A Warning from the Bench.—It is not often that a judge on the bench will give a general warning to practitioners such as that given in the Court of Appeals of the District of Columbia in the case of American Stove Company v. Detroit Stove Works, and Barstow Stove Company Barstow Stove Company v. Detroit Stove Works, and American Stove Company In the decision, Mr Justice Robb in his usual clear and forcible manner, said.

"We have observed a tendency on the part of patent attorneys to disregard the rules of evidence by asking questions more or less leading and suggestive, and it may not be amiss to state that, where timely objection is noted in the record, this court will be disposed to apply the rule and entirely disregard such testimony The witness instead of giving his independent recollection of past events becomes, by this practice, a mere echo whose recollection stimulated by leading questions keeps pace with those questions. The practice is objectionable and subversive of justice, and should be stopped."

"Penny a Pound Profit."—In the case of *ex parte* Loft, Asst Commissioner of Patents Tenner holds that writing a descriptive word in a distinctive manner does not render it registrable as a trade-mark and that the phrase "Penny a Pound Profit" is discriptive as applied to candy. In reaching his conclusion the Asst. Commissioner says the phrase is in his opinion clearly descriptive of the quality of the goods and is also of an advertising character.

RECENTLY PATENTED INVENTIONS

These columns are open to all patentees. Notices are inserted by special arrangement with the inventors. Terms on application to the Advertising Department of the SCIENTIFIC AMERICAN.

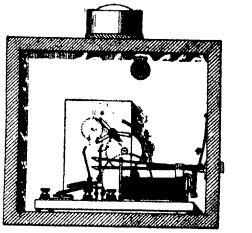
Pertaining to Apparel.

SUNSHADE.—R F. BICKERTON, 924 New York Avenue, Washington, D. C. This shade is designed for use in shielding the wearer from the sun at ball games and other athletic sports, fishing and the like; and the object is to provide a shade easily applicable to an ordinary hat and can be adjusted to any desired position around the hat in order to properly protect the wearer from the sun.

SKIRT MARKING DEVICE.—F B DAVENPORT, 38 Welles Building, Wilkes-Barre, Pa. The intention in this case is to provide a device arranged to permit convenient marking of a skirt along the lower end, with a view to obtain an accurate bottom line a desired distance above the floor, and to permit of observing after the skirt is finished, whether the bottom edge is the desired distance from the floor

Electrical Devices.

PARTY LINE TELEPHONE SYSTEM.—EDWARD STOUT and JOSEPH E KUPKA, Stockfort, Iowa In this case the more particular purpose is to produce a reliable system in which the number of telephones may be considerable and in which the selectivity of the particular station or stations to be called is rendered comparatively certain Provision is made for calling one or any larger number of subscribers, to the exclusion of all other subscribers upon the line The system further compre-



PARTY LINE TELEPHONE SYSTEM.

hends means whereby a single station may call up simultaneously all other stations on the line It also relates to lock-out mechanism, whereby when any two or more stations are connected up for talking, all other stations are excluded and are unable to interfere with business being transacted over the line The engraving shows the electrically-operated contact mechanism forming part of the switch and controlling various circuits

TRANSFORMER SYSTEM.—H C CAMPBELL, Fort Michie, New London Conn. This invention relates to transformer systems, the more particular purpose being to provide such a system in which a peculiar advantage is taken of the fact that time is required for the magnetic field to flow, under the influence of variations in the exciting electric current

Of Interest to Farmers.

SHOCK LOADER.—G H TARVIN, care of A Arrowsmith, L B 104, Slocum, S D This invention relates to a loader adapted to run along the field and pick up a shock of hay or grain and deposit it in the wagon rack carried therewith It provides a device with a fork adapted to scoop a bundle of grain or a pile of hay off the ground, and an auxiliary swinging fork adapted to remove the material from the fork and deposit it in a rack

CORN PLANTER.—M H BIRD, Sandersville, Ga The main object here is to provide means for feeding the corn at stated intervals. To this end a hopper is arranged having a sliding feed mechanism adapted to be operated by a colter wheel The hopper and feed mechanism are loosely connected to the main frame so that when an obstruction is met, the feed mechanism may rise to pass over it, automatically settling again into the furrow when the obstruction is passed

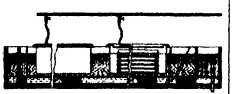
Of General Interest.

ROOF FRAMING SQUARE.—H. H. CRISS, P O Box 604, Globe, Ariz. This invention is an improvement in roof framing squares, and the object of the inventor is to provide a simple device by means of which rafters of all kinds may be laid off with absolute correctness, and without the necessity of any calculation upon the part of the user

FACIAL MASSAGE APPARATUS.—G. C. BUCK, 81 Highland Avenue, Minneapolis Minn. This apparatus is for use in applying hot water to the face, and is an improved substitute for hot-towels commonly used for facial treatment. It includes a water pan or open-top receptacle having attachments for in-

and outflow of hot water, and a device ted to be held in the mouth for supplying to support respiration while the face is d immersed in the water in the pan.

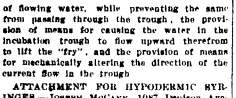
TROUGH FOR FISH HATCHERIES.—FRANK PARRY, 19 Beatrice Street, Toronto, Canada. The engraving herewith shows a ventical section of a hatchery trough constructed and arranged in accordance with the present invention, which has for its principal objects the provision of means for subjecting the "fry" while in the trough to the action



TROUGH FOR FISH HATCHERIES

of flowing water, while preventing the same from passing through the trough, the provision of means for causing the water in the incubation trough to flow upward therefrom to lift the "fry", and the provision of means for mechanically altering the direction of the current flow in the trough

ATTACHMENT FOR HYPODERMIC SYRINGES.—JOSEPH MCCANN, 1087 Denison Avenue, Columbus, O. In this invention the improvement is in syringes in which the needle is inclosed and protected by a cap that is detachably connected with the body or barrel of the instrument. The attachment is shown in the engraving in connection with the



ATTACHMENT FOR HYPODERMIC SYRINGES

syringe. It comprises the detachable needle-cap, a cone containing extra needles and wires for cleaning them, and a safety pin, for fastening, these parts being connected by chains, so that the case, cap, and syringe proper in which the cap is applied when the needle is not required for use, may be all suspended from the clothing of the physician or nurse and thus may be available for instant use

RESPIRATOR.—W I COOKE, Port Washington, L I, New York This invention comprehends a mask to be applied to the wearer's face and held in position by a strap or the like, a flexible tube connecting the mask with the outer atmosphere through the medium of an inlet valve; the mask being further provided with an outlet valve for discharging the air as the same is breathed

PHOTOGRAPHIC MAGAZINE CAMERA.—B GOLDSTEIN, 330 East 120th Street, New York, N Y This camera is arranged for day light loading and for quickly and successively discharging the exposed sensitized plates from the camera into a tank filled with a developing fluid, and for preventing the plates from being light struck while in the camera or while being transferred from the camera to the tank

NON-REFILLABLE BOTTLE.—STEVE O STAMOS 501 East Eighth Street, Anaconda, Mont. This invention provides a bottle having a neck of the shape shown in the engraving Fitting tightly in the neck a closure has an opening for the reception of a cork, this opening communicating with the interior of the bottle by means of a passage having three valve seats A by-pass communicates at

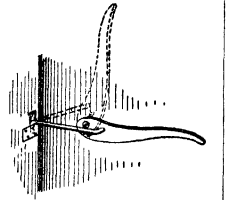


NON-REFILLABLE BOTTLE.

its top with the upper portion of the passage, but is normally cut off from the lower portion of the passage by means of a thin glass plate. Above the valve seat at the top of the passage is a valve while in the upper portion of the by-pass is a ball connected to the valve by means of a thin glass strip These novel means permit the outflow of the liquid, but will prevent introducing a liquid into the bottle.

Hardware and Tools.

HASP FASTENER.—A H BROWNE, R F D, No 6, Lebanon, O This fastener is for use on hinged and sliding doors In the engraving it will be seen that during the operation of bringing down the lever the drawer is drawn tightly against the frame and at the same time securely locked The door is thus not only secured, but a weather-proof joint is formed between it and the frame, so



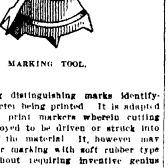
HASP FASTENER

that it cannot be rattled by the wind and the entrance of moisture is effectually prevented It may is made in rights or lefts for the application of the right side or left of a door frame It is particularly applicable to doors of tobacco barns and similar buildings requiring ventilation, since by employing different keepers the door may be held open more or less and yet securely

PAPER HOLDER FOR SCALES.—L E ZIMMERMAN, 605 N 7th street, Pekin Ill An object here is to provide an attachment to hold a paper covering upon the scale plate, thereby keeping the plate clean and in a sanitary condition The attachment holds the paper firmly in position and yet is out of way of the article so that the latter can be placed on the plate in the usual manner

SPRING HAMMER.—J H PHILLIPS, care of T B Anderson Construction Co., 24 Main Street, Oklahoma, Okla This portable hammer is for shop or field work, and is adapted to be used in various operations, such as riveting, punching, calking, shearing spike driving, stone, brick and concrete drilling, etc This automatic trip hammer receives its motive force from a compressible spring the latter having means thereon whereby the tension may be adjusted

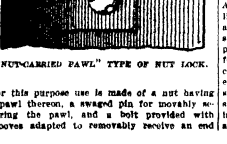
MARKING TOOL.—JOSEPH A WICKES, 54 Broadway, East Somerville, Mass The marking tool illustrated herewith represents an invention, which has in view to provide a tool with marking faces having corresponding oppositely extended distinguishing features; and to provide in a marking tool a plurality of hammer



MARKING TOOL.

heads bearing distinguishing marks identifying the character being printed It is adapted for punch or print markers wherein cutting dies are employed to be driven or struck into the surface of the material It, however, may be adapted for marking with soft rubber type and this without requiring inventive genius or act

NUT LOCK.—H T EARLES, Mount Morris Pa This invention relates to nut locks, more particularly to the "nut carried pawl" type, and has for an object to provide a device of this class for removably securing a nut to a bolt to prevent the nut from being released from the bolt by any vibration or the like



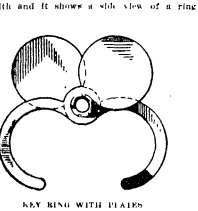
"NUT-CARRIED PAWL" TYPE OF NUT LOCK.

For this purpose use is made of a nut having a pawl thereon, a swaged pin for movably securing the pawl, and a bolt provided with grooves adapted to removably receive an end of the pawl to secure the nut to the bolt The illustration gives a view looking at the end of the bolt and showing the nut lock secured thereto

PAPER CUTTER.—M TAUSONE, P O Box 405 Ouray, Colo This invention is an improvement in paper cutters and especially in that class of cutters wherein the paper is supported in the form of a roll and is drawn from the roll as used and is cut off in the desired lengths Means provide for securing a clean cut in tearing the paper off along the blade

LOCK.—M G JASONITA 1140 First Avenue, New York, N Y This invention has for its purpose the provision of a lock wherein the bolt will be released and assume an unlocked position when a key is inserted in the lock in the usual manner to operate the same Besides being secured to the side of a door the lock can be employed in any convenient manner such as a mortise lock on the like

KEY RING.—CHARLES SCHUMACHER, 713 First Avenue, N S, Pittsburgh, Pa Among the principal objects which the present invention has in view are to provide a ring having arms frictionally held to form a ring, to provide a pivoted member for attachment to a chain, and to provide a device of the construction set forth with a plurality of advertising plates two of which are covered during the major portion of the time The device is illustrated herewith and it shows a side view of a ring



KEY RING WITH PLATES

in open position The solid plates at the top are employed as a means for advertising articles and for imprinting thereon the name and address or other information relative to the owner to serve as a partial identifying article The inventor invites correspondence in reference to the sale of this improvement

Heating and Lighting.

LAMP ATTACHMENT.—H LEHMANN, 9114 Washington Street, Waco, Tex This invention has reference to lamp attachments and the object is to provide a device for use in preventing lamp explosions, to serve as a means for heating liquids over a lamp and to prevent the cracking and breaking of lamp chimneys

Household Utilities.

AUTOMATIC DISINFECTING DEVICE.—T F HARVEY, 78 Webb Street, Chelsea, Mass The present invention has reference to an automatic liquid disinfecting device, which is adapted to be attached to the flushing tank of a water closet, whereby a certain amount of disinfectant may be supplied to the water in the tank each time the tank is operated

Machines and Mechanical Devices.

WASHING MACHINE.—E KOHAN, Port Ewen N Y This apparatus will wash clothing without rubbing, whether mechanically or by hand It cleanses simply by the physical action of running water and air, the water carrying a proper amount of dissolved soap and it cleanses gently but thoroughly without the wear and tear usually met with when clothing or the like is washed by hand or laundried by machines

SAFETY GATE FOR ELEVATORS.—H L BRAYTON 225 South Howell Street Owosso Mich This improvement relates to means for opening and closing elevator gates automatically by the movement of the elevator cage or car, and the aim is to provide a mechanism which will be located entirely in the elevator shaft readily accessible in all its parts and which will not require any counter weights

CALF WHEEL.—T A BEECHER, Taft, Cal In this patent the invention has reference to artesian and oil wells, and has for its object to provide a wheel and shaft for use in raising and lowering casings into drilling wells and as known among those skilled in the art of well drilling, a further object is to keep the casing loose

COMBINED BULL WHEEL, TUG WHEEL, AND MOUNTING REEL THEREFOR.—T A BEECHER, Taft, Cal This invention provides a construction to withstand shocks to which structures of this character are subjected provides to facilitate a division of the reel for winding the cable whereby a plurality of cables may be employed, provides a structure evenly and firmly keyed to the supporting shaft to distribute torsional strains of the structure, and provides means for readily truing the bearing of the structure on the shaft and to eliminate vibration from the structure.

MEANS FOR TEACHING AVIATION AND TESTING AEROPLANES.—W F MANGELS, Coney Island New York, N Y A means is provided in this invention to enable a person to acquire with the utmost safety all the necessary skill and confidence required for a flight in the open air with an aeroplane or other flying machine and to allow aviators to fully test the motors and other parts with safety to themselves and the aeroplane

REVOLVING PLANE.—J HAYDEN, Box 558, Salt Lake City, Utah This invention has reference to revolving planes for flying machines, to take the place of the stationary planes now used therein An object is the provision of a device which will be simple in construction, inexpensive to manufacture, strong, durable easily controlled and having a great supporting efficiency

Pertaining to Recreation.

CUE RACK.—M R BASS and W A ALEXANDER, 2 Oneida Street Boston Mass This rack is so constructed as to provide for imparting longitudinal compression to the cue while in the rack, for impelling the tips of the cues, and at the same time to so support the cues while under the compression action as to prevent lateral movement of the cues The rack can safely hold the cues when in seated therein, and prevent their withdrawal without the consent of the user or owner of the cues

GAME APPARATUS.—J V B RAPP, 507 Fifth Avenue, Brooklyn New York, N Y In this game use is made of a field having the home plate and bases marked thereon indications of plays adjacent the home plate and bases and a revolvable spinner or pointer pivoted to the center of the field and having four points adapted to indicate on the said indications on the home plate and bases

REEL.—H HALL Paonia Colo This invention relates generally to reels adapted to be applied to fishing rods such as is the subject matter of the patent No 977,742 formerly granted to Mr Hall and more particularly it relates to a reel having gearing therein cooperating with the reel proper and the handle, wherein successive turning of the handle in opposite directions will cause the line to wind up in the reel

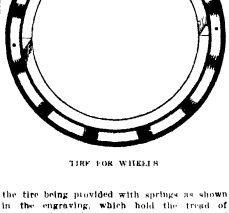
Railways and Their Accessories.

METALLIC RAILWAY TIE.—J N KEMMERER, Logansport Clinton Co Pa In the present patent the object of the inventor is to provide a metallic tie which shall combine maximum strength rigidity, and lightness and may be manufactured at a low cost may be easily placed in and removed from the roadbed, and will support rails firmly without danger of moving endwise

Pertaining to Vehicles.

RESILIENT WHEEL.—F MORRIS 2912 Farnam Street Omaha, Neb This improvement pertains to resilient which wheels or combined cushion and pneumatic tire wheels An object of the invention is to provide a wheel which will have the same resiliency as an ordinary pneumatic tire wheel, but which is so constructed that the pneumatic tire does not come in contact with the ground and is thereby protected against puncture

TIRE FOR WHEELS.—FRANK GATTACHER, Route 2 Canton Minn In this patent the invention has reference to tires for wheels, and it has for its object the production of a tire which may be readily adjusted to a wheel,



TIRE FOR WHEELS

the tire being provided with springs as shown in the engraving, which hold the tread of the tire yieldingly extended from the felly of the wheel The tire is made in sections which are bolted together around the felly of the wheel The number of springs in each tire may be regulated with reference to the use to which the tire is to be put The illustration pictures the tire in longitudinal section

NOTE.—Copies of any of these patents will be furnished by the SCIENTIFIC AMERICAN for ten cents each Please state the name of the patentee, title of the invention, and date of this paper

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Compiled and edited by A. RUSSELL BOND. 12mo., 467 pages, 370 illustrations. Price, $2.00.

¶ This is a compendium of hundreds of valuable suggestions and ingenious ideas for the mechanic and those mechanically inclined, and tells how all kinds of jobs can be done with home-made tools and appliances. The suggestions are practical, and the solutions to which they refer are of frequent occurrence. It may be regarded as the best collection of ideas of resourceful men published, and appeals to all those who find use for tools either in the home or workshop. The book is fully illustrated, in most cases with working drawings, which show clearly how the work is done

Concrete Pottery and Garden Furniture

By RALPH C DAVISON 16mo., 196 pages, 140 illustrations. Price, $1.50

¶ The book describes in detail in a most practical manner the various methods of casting concrete for ornamental and useful purposes. It tells how to make all kinds of concrete bases, ornamental flower pots, concrete pedestals, concrete benches, concrete fences, etc. Full practical instructions are given for constructing and finishing the different kinds of molds, making the wire forms or frames, selecting and mixing the ingredients, covering the wire frames, modeling the covered plastic into form, and casting and finishing the various objects. With the information given in this book, any handy man or amateur can make many useful and ornamental objects to consist for the adornment of the home or garden. The information on color work alone is worth many times the cost of the book

The Design and Construction of Induction Coils

By A. FREDERICK COLLINS. Octavo, 295 pages, 159 illustrations. Price, $3.00

¶ The work goes in minute details full practical directions for making eight different sizes of coils, varying from a small one giving a spark-inch long to a large one giving twelve-inch sparks. The dimensions of each and every part down to the smallest screw are given, and the directions are written in language easily comprehended. Much of the matter in the book has never before been published as, for instance, the vacuum drying and impregnating processes, the making of adjustable mica condensers, the construction of interlocking reversing switches, the set of complete wiring diagrams, etc. The illustrations have all been made from original drawings, which were made especially for this work.

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Notes and Queries

Kindly keep your queries on separate sheets of paper when corresponding about such matters as patents, subscriptions, books, etc. This will greatly facilitate answering your questions, as in many cases they have to be referred to experts. The full name and address should be given on every sheet. No attention will be paid to unsigned queries. Full hints to correspondents are printed from time to time and will be mailed on request.

(12569) G. W. G. says: In a recent issue I saw an article referring to a discussion in the English papers of the meaning of the word "anticyclone." Now, it is an interesting fact to which I would call your attention that the word "cyclone" is used by different people to denote each of the three different kinds of atmospheric whirls, which are distinguished absolutely from one another by meteorologists. In the newspaper vernacular it means a tornado, in French, and by implication the other Romanic countries, it means a hurricane or typhoon, with its proper meaning, according to our American meteorologists, is a broad flat whirl, known more familiarly as a "low." This is designated in French science by the term *Bourrasque*, which popularly connotes merely a storm. Will you not take this matter up, and inform your readers where and by whom the word "cyclone" was originated, and what it originally signified, and how it came to be appropriated to mean three different things. This would make more clear the true and proper significance of the word, as well as, naturally, that of the word "anticyclone," which appears to be used everywhere in its proper significance, for the obvious reason that there is, and can be no such thing as antihurricane or an antityphoon. The word "cyclone" was invented by Henry Piddington, of Calcutta, one of the founders of the modern theory of storms, and first appeared in his well-known Sailor's Horn Book, published in 1848. It was irregularly formed from the Greek word for circle, and was applied by its author to "all circular or highly curved winds . . . without any relation to the *strength* of the wind." Among the winds coming under this generic designation he enumerates hurricanes typhoons, whirlwinds, African tornadoes, simoons, and with a note of interrogation—"some gales of high latitudes." Under the term "whirlwinds" he would doubtless have included what is now called in America a "tornado"—and popularly a "cyclone"—the African tornado being a kind of the second variety. If Piddington were writing to day, he would hardly include the latter among the "cyclones." While, with advancing knowledge of the mechanics of the atmosphere, the application of this word has varied from one general notion of meteorologists to the next current usage in regard to it is nearly uniform in all languages. The "cyclone" of Hann's "Lehrbuch der Meteorologie" (even "Zyklone" by most other Germans) is identical with the "cyclone" of English and American meteorologists, while if our correspondent will consult Hildebrandson and Teisserenc de Bort's "Traité Atlas Général de dynamic meteorology, "Les bases de la météorologie dynamique," he will find that "cyclone" has the same application in French. Modern scientific usage recognizes only the two somewhat different forms of atmospheric whirl, viz., tropical (properly "intertropical") and extra-tropical cyclones, but not to the relatively small and local whirls known as spouts (waterspouts and landspouts—the latter including tornadoes), which are believed to originate in the upper atmosphere, or to the small dust-whirls and the like, due to local convection just above the ground. It must be admitted, however, that many meteorologists are so far influenced by the popular identification of cyclones with violent storms that they avoid the use of this word in the study of the cyclonic wind-systems of middle latitudes, which are not necessarily stormy, *preferring to refer* to those systems as "depressions," "barometric minima," "lows," etc. The same writers freely apply the word "cyclone" to the moving low-pressure systems within the tropics, where such disturbances always assume the character of storms, and are usually so violent as to deserve their alternative name "hurricane." Thus J. Algué's standard work on typhoons is entitled "The Cyclones of the Far East." *The fact that tropical cyclones are always storms—and usually violent storms—probably explains how the word "cyclone" came to be identified, in the popular mind, with a severe wind-storm.* This particular class of cyclones having been the subject of a great amount of practical discussion addressed to mariners, the term probably passed by way of the nautical vocabulary into the vocabulary of everyday life. Popular usage in this country is so nearly unanimous in identifying the cyclone with the tornado that lexicographers have been forced to accord a measure of recognition to this application of the word "cyclone," and it has even received the approval of the law courts. (See an interesting decision of the United States Circuit Court of Appeals reported in the *Monthly Weather Review*, June, 1907, p. 280 fg.) The word "bourrasque" has, as our correspondent states, been applied in French scientific literature to ordinary cyclonic disturbances, but is now obsolescent in this sense, and was never the *usual* term. A "bourrasque" is properly a violent and transient wind, especially a squall. This term belongs to the family of words—including "bora," "burran," etc.—derived from the Greek "boreas"—the blustering north wind blowing down from the mountains.

(12570) E. Q. K. writes: I wish you would explain the discrepancy between theory and observed facts which I have noticed in regard to the vernal and autumnal equinoxes, the period when the days and nights are equal in length. The dates are about the 21st or 22nd of March and September, according to the astronomers, yet the almanacs report a considerably longer day than night on those dates. Are the almanacs wrong, or do they give times of *apparent* sunrise and sunset, and are there reasons why the apparent time is not the real time of these occurrences?

I take the following from the *World* almanac for 1910:

	Sun rises	Sun sets	MARCH.
18th	6.0	6:9	(day and night equal on 18th)
19th	6:7	6:10	(day exceeds night by 3 minutes)
20th	6:5	6:11	(day exceeds night by 6 minutes)
21st	6:3	6:12	(day exceeds night by 9 minutes)
22nd	6.2	6:14	(day exceeds night by 12 minutes)

This would seem to make the 18th the date of the vernal equinox instead of the 21st.

	Sun rises	Sun sets	SEPTEMBER
21st	5 45	6 1	(day exceeds night by 16 minutes)
22nd	5:46	6 0	(day exceeds night by 14 minutes).
23rd	5:47	5.58	(day exceeds night by 11 minutes)
24th	5:48	5 56	(day exceeds night by 8 minutes)
25th	5.50	5.55	(day exceeds night by 5 minutes)
26th	5:51	5:53	(day exceeds night by 2 minutes)
27th	5.52	5.51	(night exceeds day by 1 minute)

Here the autumnal equinox appears to come somewhere between the 26th and 27th of September, while the 21st and 22nd show a large excess of daytime. A The times of sunrise and sunset as given in the almanacs are those at which the upper edge of the sun appears or disappears at the true horizon. As the sun is half a degree in diameter, and in our latitude goes down obliquely, this takes place 1½ minutes earlier at sunrise, and later at sunset, than the moment when the sun's center is on the horizon. This alone would make the day three minutes longer than the night when the sun is at the equinox. To this must be added the effect of atmospheric refraction, which raises the sun, when near the horizon, by half a degree—his whole diameter. This makes sunrise three minutes earlier and sunset three minutes later than otherwise would be the case. The combined effect of these two causes makes the day nine minutes longer than the night on March 21st and September 21st.

(12571) J. E. L. asks: Could you answer the following question to set some minds at rest? In playing baseball with the baseball series just past. You need not be surprised to hear from such a far western country and from people who seem to be so much interested in the American national game. Mostly all of us come from there. The question is. Would a *slow* ball met squarely in the face by a *bat*, rebound farther back than the same ball, being swift, met by the same bat with the same *force* behind? *If* it is possible to give some reasons to explain the natural result, it would set many minds at rest. A *fifty-in* a ball and bat of regulation size and a certain amount of energy between the ball and the bat, the ball will go to a certain distance with a certain velocity. It does not seem to us to make any difference whether the ball or the bat has the energy in equal or unequal portions, if the total energy is the same. That is, if the ball is at rest and is struck with a whole force, it will go with the same speed and to the same distance as if the bat were at rest and the ball struck it with this force, or if bat and ball are both in motion and come together when each has half of this force. In each case the ball will have the same force after rebound. The fact is that such a condition is not realized in an actual game. The batter sees the ball coming swiftly and puts in more force than if the ball were thrown slowly, and this is done instinctively. He must put more force into the bat, so that it may have the velocity necessary to find the swift ball before it gets past him. Balls are pitched swiftly, since there is more chance that a swift ball will be missed, and go to the catcher. The specific question which you propose can now be intelligently answered. The swift ball rebounds from the bat farther than a slow one can if the bat has the same force in the two instances, because the rebound is the sum of the force of the ball and of the bat. The rebound is due to the entire

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force at the point of rebound, that of the bat and the ball. The force of the bat is the same both times, but the slow ball has less force than the swift ball. Hence the rebound of the slow ball is with less force than that of the swift ball. The resulting velocity is less, and the distance to which it flies is less

The Current Supplement

IN the current issue of our SUPPLEMENT, No 1874, Marconi, the pioneer of the art of radio-telegraphy, concludes his account of its development.—The largest electric generator in the world has recently been installed by the New York Edison Company on the East River, New York city. An illustrated account of the starting up of this giant turbine and generator furnishes the frontispiece of this issue.—An automatic device for preventing the unduly sudden rise of current on closing the switch of a motor, presenting an important advance in the design of this type of apparatus, is described and illustrated.—The handling of materials, both raw and finished, in manufacturing plants, is a very important problem at all times. Some interesting examples of what has recently been done along these lines are described and illustrated.—A very interesting review of the speed records attained by various methods of locomotion, both on the earth's surface and above it, is reproduced from Nature, in which Prof Hele-Shaw's address before the Royal Institution was originally published.—Mr J J Ide, who has been contributing some very excellent articles on various types of flying machines, this week tells us of the Deperdussin monoplane.—An article containing much useful information on wire and wire ropes in aeroplane construction is reproduced from the *Electrician and Mechanic*.—Our astronomical readers will take interest in an article on the orbit of Beta Persei.—Other subjects tell of the automatic regulation of boiler water, the power derived from ocean waves, and the deceptions to which our senses are subject

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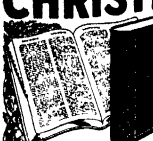
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The Heavens in December, 1911

(Concluded from page 504.)

and very bright. He is south of the Pleiades at the beginning of the month, and moves slowly westward Telescopically he shows a disk about 19 seconds in diameter, upon which much detail may be seen under favorable atmospheric conditions By the end of the month his distance has increased from 49 to 64 millions of miles, and he appears correspondingly fainter and smaller.

Jupiter is morning star in Scorpio, rising about 5.30 A. M. in the middle of the month

Saturn is in Aries, well past opposition, but still conspicuous in the evening sky

Uranus is in Capricornus, too near the Sun to be observed. Neptune is in Gemini, approaching opposition, but too faint to be seen without a telescope.

The Moon is full at 10 P. M on the 5th, in her last quarter at 1 P M. on the 12th, new at 10 A. M on the 20th, and in her first quarter at 2 P. M. on the 28th She is nearest the Earth on December 6th, and farthest away on December 21st

In her circuit of the skies she passes near Saturn on the night of the 3rd, Mars at 11 P M. on the 4th, Neptune on the 8th, Venus on the 16th, Jupiter on the 18th, Mercury on the 21st, Uranus on the 22nd, Saturn again on the 31st, and Mars once more about three hours after the new year begins

The two conjunctions with Mars are close As seen from Washington, the planet is about 15 minutes south of the Moon's limb on the 4th, and about 20 minutes north on New Year's Eve

Princeton University Observatory

The Manufacture of Yeast

(Concluded from page 496.)

passed between cylindrical rollers which bruise it without grinding it to powder. The product is now mixed with water, whereby the so-called must or saccharine liquid for fermentation is obtained. The preparation of this liquor is carried out in double-bottomed macerating tubs, heated by steam and provided with mechanical agitators The materials fed into these tubs consist of a mixture in about equal parts of flour and barley, the diastase in the malted barley being sufficient to turn into sugar not only the starch contained in the grain itself, but a further quantity, furnished in the form of untreated starch It is, of course, an economy to malt only a portion of the grain and make it do duty for saccharifying both its own starch and a further quantity upon which no malting operation has been performed As soon as the saccharification is complete, the product, in form of a doughy slush, is introduced into double-bottomed copper coolers, in which it is cooled down to 20 deg Cent From the refrigerator the must is distributed to a number of tubs of 220,000 gallons each, arranged in a special room, whose temperature is maintained constant through summer and winter, as this is an indispensable factor for the successful operation of the process The tubs are then inoculated with a quantity of yeast carefully prepared. The temperature of the must reaches 25 deg Cent at the start, and must not be allowed to exceed 30 degrees. It is important to rigorously observe these limits of temperature and to be scrupulously careful in the preparation of the grain, in maintaining the right proportions for the mixture, and in insuring absolute cleanliness of every part of the plant From time to time, until the fermentation is completed, the yeast is gathered from the surface of the liquid in the tub. The yeast is then sifted in order to separate it from the malt and the mucilaginous material admixed with it, whereupon it is passed through a filter press which delivers it in the shape of slabs or cakes. Finally, the yeast is stamped in a briquetting press and made up in parcels of one pound, two pounds, and one-half pound, which are carefully packed in double wrappers for delivery to bakers and pastry cooks

The must, on the other hand, after the fermentation is completed, is carried off to reservoirs in the cellar, whence it is pumped to the stills. By a series of suc-



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Correspondence

[The editors are not responsible for statements made in the correspondence column Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.]

Chinese Wood-oil Tree

To the Editor of SCIENTIFIC AMERICAN.

In your issue of September 23rd, at page 275, you express the opinion that the Tung, or Chinese wood-oil tree, "might flourish in warmer parts of the United States"

My purpose in writing this is to inform you that it does flourish in Louisiana as far north as Red River in the central part of the State of Louisiana Here at Abbeville, in the southwestern portion of the State, near the Gulf of Mexico, I have several trees measuring nine inches in circumference and over twenty feet high, which mature their fruit and are only four years old It is of erect habit, handsome appearance its branches are easily controlled, and I should consider it an ideal ornamental tree for cities where the crowded conditions of tall walls and buildings leave little room for the ordinary trees It flowers early in the spring, and its blossoms are very beautiful and quite fragrant.

Abbeville, La C J EDWARDS

Nitrogen and the Soil

To the Editor of SCIENTIFIC AMERICAN

It has just now come to our notice that in the edition of the SCIENTIFIC AMERICAN published August 19th, 1911, there was a communication from Dr J G Lipman of the New Jersey Agricultural Experiment Station, in which he claims that the priority of discovery that "a legume growing with a non-legume causes the latter to contain a higher nitrogen content than if the non-legume were grown alone" rests with him, or as he expresses it, with the New Jersey Experiment Station If his objection is based on the contention that this fact was announced by him before it was by the undersigned, his position is untenable, as we published conclusive evidence of this in the *Journal of Industrial and Engineering Chemistry*, July, 1910, and also presented it at the Omaha meeting of the American Society of Agronomy December 7th and 8th, 1909 The latest of these was several months previous to the appearance of the article in the *Journal of Agricultural Science*, Vol III, Part III, and the note in the Report of the Office of Experiment Stations for 1909 in which Dr Lipman claims to have made a similar announcement, both of which publications appeared in October, 1910

Our article on "Availability of Soil Nitrogen in Relation to the Basicity of the Soil and to the Growth of Legumes" contained a detailed description of our investigation, including statements of analysis of the non-legumes grown with and without legumes This article was received by the editor of the *Journal of Industrial and Engineering Chemistry* on April 21st, 1910, and appeared in July of that year. The articles published by Dr Lipman in which he claims to have made a similar announcement were the follow ing: "A Method for the Study of Soil Fertility Problems," which appeared in the *Journal of Agricultural Science*, Vol III, Part III, and was received at the Cornell University Library on October 12th, 1910, and a brief note in the Annual Report of the Office of Experiment Stations for 1909, which publication bears the date of issue October 10th, 1910, on its cover.

It will be noticed that both of these publications appeared several months after our article in the July number of the *Journal of Industrial and Engineering Chemistry*. In neither of Dr. Lipman's publications are any figures given to show that the fact had been demonstrated, that legumes may increase the nitrogen content of non-legumes growing with them

We have a high respect for Dr Lipman's work, and have no doubt that he had come to the same conclusion that we had reached as the result of his own work, but we feel that it was only proper that we should make this explanation to show that we announced the fact before Dr Lipman did, and furthermore published our results in detail We regret that a public explanation is necessary, but the communication in the August 19th number of this journal requires this It is altogether probable that Dr Lipman failed to see our article in the *Journal of Industrial and Engineering Chemistry* before he wrote his communication

T L LYON,
J A BIZZELL
New York State College of Agriculture and Experiment Station at Cornell University, Ithaca, N Y

The Naval Review at New York

To the Editor of SCIENTIFIC AMERICAN

The fleet that was reviewed by President Taft on the second of November was the most formidable ever assembled in American waters, exceeding by a wide margin the allied fleet that participated in the Hudson Fulton celebration two years ago

Comparing the Atlantic fleet of that time with the present, we find that the strength in pre-dreadnought vessels is about the same while the addition of the six all-big gun ships more than offset the foreign vessels that were in the Hudson at that time

The English flagship "Inflexible" would be easily outfought by the "Delaware," while the three remaining cruisers would be mere stationary targets for the powerful 12-inch gun batteries of the "Utah" and "South Carolina" Admiral Von Roesters German vessels would find the lone "North Dakota" more than a match for them The ill-fated "Liberté" and her sister ships "Justice" and "Verité," carrying four 12-inch guns each could make but a feeble fight against the combined attack of the "Florida" and "Michigan." Unaided by the cruisers, the veterans "Indiana" and Massachusetts" could dispose of the remaining foreign vessels with a few effective broadsides.

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Upbuilding Our Merchant Marine

To the Editor of SCIENTIFIC AMERICAN

Since writing you within the past few weeks the writer has eagerly scrutinized your correspondence column, hoping to find some manifestations of interest from your readers on the revival of the American merchant marine If all the great journals in this broad land would do as much as you have already done to enlighten the public on this subject, the great mass of the people, in the interior especially, would be much better informed in regard to the actual status of our shipping interests Such information would enable and incline them to send more statesmen and fewer demagogues to Congress, and would result in the enactment of such a shipping law as would stimulate our foreign commercial interests, and at least lay the foundation for such a merchant marine as would command the respect of the nations of the earth.

The situation calls for immediate action, and the friends of American shipping interests should endeavor, if possible, to accomplish something at the approaching session of Congress

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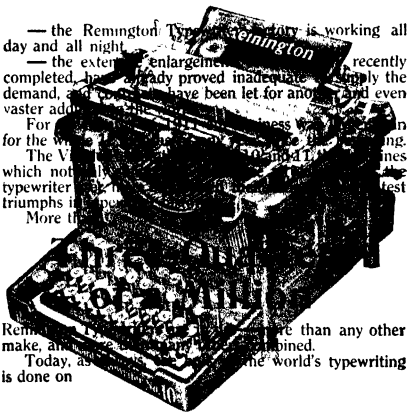
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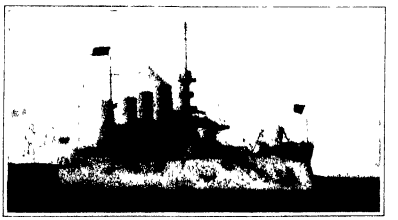
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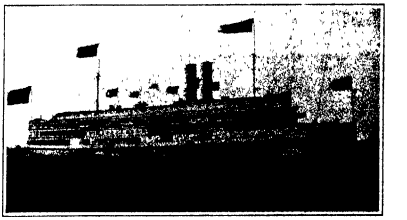
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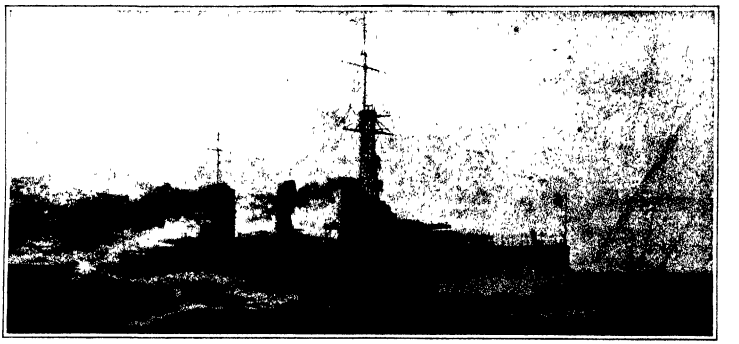
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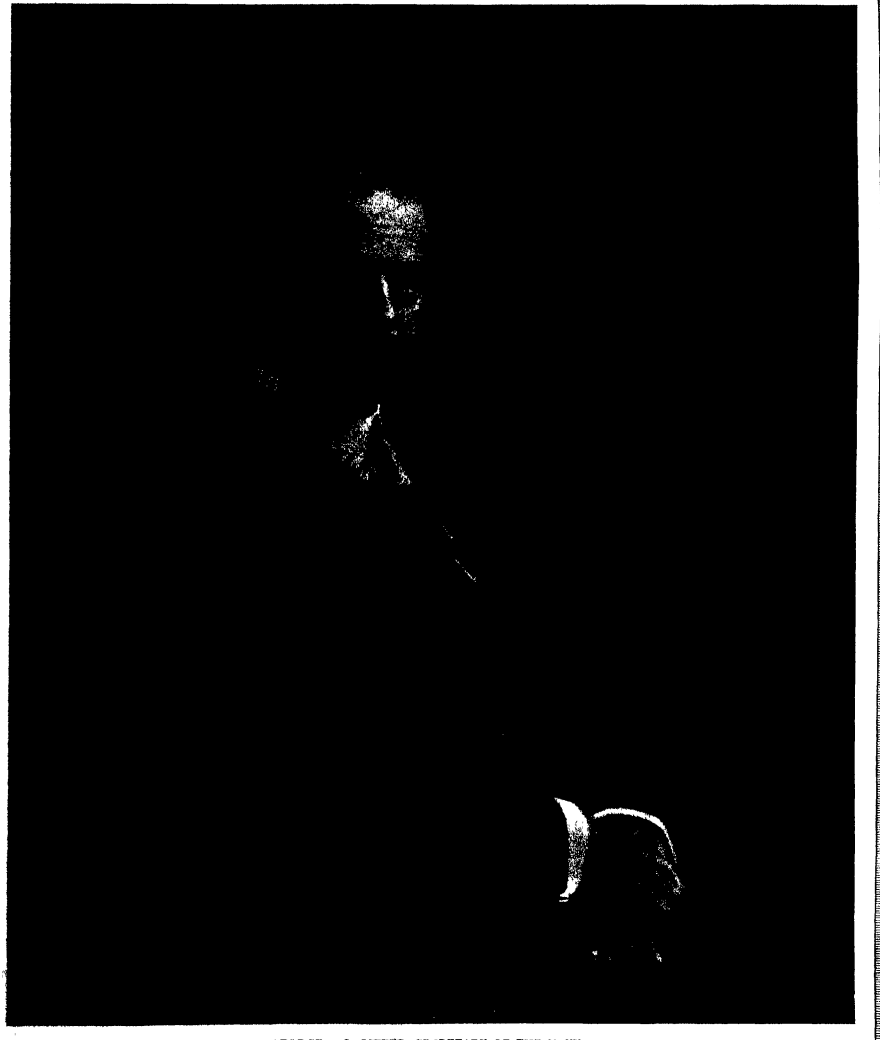
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The purpose of this journal is to record accurately, simply, and interestingly, the world's progress in scientific knowledge and industrial achievement

The Importance of the Command of the Sea

THE existing contest between Italy and Turkey, confined as it is to the sea and to the possession of Tripoli, has a double interest. It illustrates on the one hand the gradual yet perpetual process by which a higher civilization impinges upon a lower that is, upon one that is lower in ability, efficiency however in some instances it may have been higher in acquired material comfort, or even in literary and artistic achievement. This tendency can neither be regulated by law, nor brought to the bar of law without injury to the progress of the world toward better universal conditions to which end it is essential that the efficient supplant the inefficient. On the other hand this collision illustrates the importance of the command of the sea. This also it should be noted, has been incidental and determinative in the progress of the world. Through having this command Italy thus far has been able to localize the land fighting in Tripoli and probably can continue to do so, to the great relief of her own resources, and that of a watching and anxious Europe.

It is to this second consideration that I am here limited in my subject—"The Importance of the Command of the Seas" with a somewhat special reference to that importance as touching the United States. The United States in her turn, after having achieved national efficiency by the quenching of internal discord in a bitter and bloody contest, has found herself compelled inevitably into the same path of seeming aggression upon less efficient social and political communities, to bear her part of "the white man's burden" as it has been styled. For in essence this process is not one of *aggrandizement*, but of *responsibility*—responsibility not to law, which always lags behind conditions, but to moral obligation entailed by the particular circumstances of the moment of action.

This moral side of the question is not irrelevant to the military one of the importance of commanding the sea; for granting the end, the moral obligation—the means, if not themselves immoral follow as a matter of course. Of such means *command of the sea* is one. Napoleon said that *morale* dominates war, and it is correspondingly true that a sense of right power unites to reinforce the stability of national attitude and the steadfastness of national purpose. If we have been right morally step by step, in the forward march of the past few years, we are morally bound to sustain the position attained by measures which will provide the necessary means. Of these an adequate navy is among the first, probably in our case, the chief of all.

Here, as always, it is necessary to recur to experience—to the past—in order to comprehend the present and to project the future. Why do English innate political conceptions of popular representative government, of the balance of law and liberty prevail in North America from the Arctic Circle to the Gulf of Mexico, from the Atlantic to the Pacific? Because the command of the sea at the decisive era belonged to Great Britain. In India and Egypt administrative efficiency has taken the place of a welter of tyranny, feudal struggle, and bloodshed, achieving thereby the comparative welfare of the once harried populations. What underlies this administrative efficiency? The British navy, assuring in the first instance British control instead of French and thereafter communication with the home country, whence the local power without which administration everywhere is futile. What, at the moment the Monroe Doctrine was pro claimed, insured beyond peradventure the immunity from foreign oppression of the Spanish-American colonies in their struggle for independence? The command of the sea by Great Britain, backed by the feeble navy but imposing strategic situation of the United States, with her swarm of potential commerce-destroyers, which a decade before had harassed the trade of even the mistress of the seas.

Less conspicuously but no less truly, to what do Algiers and Tunis, and to what eventually will Morocco, owe redemption from conditions barely, if at all, above the barbarous? To the command of the sea by the nation which already has restored the former two to be fruitful members of the world community. That South Africa is now a united commonwealth, instead of two opposing communities, such as the North and South of our own country might have been, is due to the same cause, a local preponderance of force insured by sea power. It may safely be claimed that to the navy of the United States chiefly is owing the present Union, instead of the existence of two rival nations vying or trying to vie, with each other in *military preparations* like the nations of Europe. The four years' struggle of the Confederate States might not have ended in exhaustion, had it not been for the blockade, which shut in their cotton and shut out their supplies.

Contrast this impressive exhibit where the command of the sea has been operative, with the history and achievement of those great States which have not possessed it. Contrast Bosnia and Herzegovina for Austria Alsace and Lorraine for Germany, with the expansion of France, Great Britain Holland and with that which Spain once possessed now lost through an inefficiency, one of the first symptoms of which was the decay of her navy. The magnificent efficiency of the present German Empire strives now, against almost hopeless disadvantage, for the opportunity to exercise that efficiency outside its European limits. Opportunity was lost through the absence of naval force, in the past centuries, when the maritime countries were occupying and in accordance with their respective political aptitudes, were determining the future of immense tracts of the world. Much time must elapse before we shall know the inside history of the still unarranged dispute with France about Morocco, but there is reason to believe that the consciousness of the British navy at the back of France has been one of the large factors in the negotiations. At least it is apparent that *bitterness against Great Britain* has been even more marked than against France.

The lesson for the United States is plain. In the strategic position before mentioned, in remoteness from Europe, in the rivalries of European nations we still have a local and international advantage for preponderance in American waters, but it is not so great as to confer certainty without reasonable provision for *insuring command of the sea*. In the Pacific which is equally our coast line, and to which the future mostly looks, we have no similar advantage. Much as I dislike and reject the phrase "supremacy in the Pacific," it is true that we there have duties which in case of disputes will require the presence of naval force adequate to command. Duty to the mutual support of our two chief coasts dictates full control of the Panama Canal, which from the military standpoint is the key to any broadly planned system of preparation for national defence.

But obligation is no less on account of the Philippine Islands. Having assumed control of these under imperative circumstances we are bound in honor to support an undertaking, our fitness for which is attested by results. To them we are responsible for the maintenance of conditions under which material prosperity can advance, and their dissimilar and discordant inhabitants, reach a homogeneous civilization and political development which will enable them to govern themselves. To Cuba, though independent, we owe by specific guarantees the maintenance of a like internal security. These national and international functions can be discharged, certainly only by command of the sea. The Pacific the Atlantic, and the Caribbean with the great controlling stations, Porto Rico, Guantanamo, the Canal Zone, and Hawaii depend upon this command, the exponent of which is the navy, and in which ships and stations are interdependent factors. To place the conclusion concretely and succinctly, the question of command of the sea is one of annual increase of the navy. This question is not "naval," in the restricted sense of the word. It is one of national policy, national security, and national obligation.

A. T. Mahan
Rear Admiral, U. S. N.

For an Adequate Navy

IN common with all who believe in the ultimate triumph of the best in human nature, we look forward confidently to that enlightened era, in which the exercise of mutual consideration and simple common sense shall have rendered possible the abolition, in part if not in whole, of the world's vast armaments, and the substitution therefor of an international court of arbitration.

For those of us who have learned to look upon questions of international moment from the broadest possible standpoint, however, it is impossible to overlook the fact that the question of arbitration and partial or complete disarmament is intimately, nay essentially, bound up with our relation to that populous Oriental world—Mohammedan, Buddhistic, and Confucian—whose teeming millions are only now being quickened to a realization of the dignified position which, by every right of ancient civilization and their unquestioned mental equipment and physical resources, they seem entitled to fill in the future history of the world.

The awakening of the Orient *to a sense of its latent* powers—ushered in, as it was, by the stupendous drama of the Russian-Japanese war, and echoed in the present unrest in India and China, and the existing struggle between Christian and Mohammedan armies—may well give us pause and confirm in us the conviction, voiced by our President, the most distinguished advocate of international arbitration, that "until peaceful means of settling all international controversies are assured to the world, prudence and patriotism demand that the United States maintain a navy commensurate with its wealth and dignity."

The SCIENTIFIC AMERICAN, then, stands for an adequate navy, not for aggression, but as a reasonable insurance upon the national wealth of the United States, which at the last official estimate, in 1904, had reached the vast total of over one hundred and seven billions of dollars. In the absence of an army adequate for our defense, the protection of our lives and property becomes the duty of the navy, and last year we placed upon the population and wealth of the United States a naval insurance of one hundred and fifty-six million dollars—a very moderate rate of one and one-half per cent. In view of the fact that because of our geographical location we are free from the burden of such enormous armies as are maintained by contiguous European nations, "prudence and patriotism" demand that we carry additional naval insurance, by adding to our line of defense annually, the four capital ships which are deemed necessary by the Naval Board at Washington.

The SCIENTIFIC AMERICAN stands for an adequate navy, furthermore, because we believe there is no national institution in which the best traditions and finest characteristics of the American people are more *carefully fostered* and *conserved*. Nor can we recall any institution, public or private, professional or commercial, in which the national ideals are more lofty, or the measure of their attainment so great. Here, at least, patriotism is divorced from material profit, and here the Flag is scrupulously honored as the sublime emblem of all that is noblest in the past history and future aims of the American people.

The SCIENTIFIC AMERICAN stands for an adequate navy because, as stated by one of the writers in this issue, the navy has been truly designated as a "great American university," in which nearly 50,000 men and youths are being trained in that "respect for constituted authority" to the lack of which, as much, perhaps, as to anything else, are to be attributed the more serious of our social, commercial and political evils.

We believe in an adequate navy, also, because both at Annapolis and in the subsequent routine of official life, the service has developed a body of men who reach a higher professional standard of ethics than can be found, probably, in any of the professions to-day. In his ever-ready subordination of self-interest to the interests of the service, the naval officer stands for the finest traditions of the professional man; and in the matter of zeal and sobriety, we believe that he has reached a higher mark than any recorded in the past history of the United States navy. We speak of sobriety from the standpoint of intimate knowledge, for it was the Editor's privilege recently, as guest in the wardroom mess of one of our ships, to note that, when the wine was served, one-half of the glasses were turned down—this, mark you, on the score that it tended to efficiency.

Lastly, the SCIENTIFIC AMERICAN stands for an adequate navy, because the national funds expended on the construction of ships and their equipment have served to originate and keep alive not a few of the industries of the country. But for the work afforded by the contracts for new ships for the navy, some of the finest shipyards in the country would have closed their gates, and the death blow would have been given to our all-but-defunct merchant marine.

The Business Management of the Navy

By G. v. L. Meyer, Secretary of the Navy

THE essentials of administration are organization, co-ordination and efficient methods.

At the end of the previous administration a beginning was made in consolidating the shops at the navy yards Under the old system, in existence for many years, each bureau had its own shops and its own workmen. Work is now done for any bureau in general shops.

In order that the head of the Navy might be informed and have responsible expert advice, and coordinate the efforts of the bureaus, an organization was put in force December 5th, 1909, with the knowledge and approval of the President, by which four aids were appointed and the bureaus were grouped in divisions of Operations, Material, Personnel, and Inspections. The Aid for Operations has charge of movements of ships, grouping into fleets and squadrons, and preparation of war plans and strategic studies The Aid for Material studies the requirements for repairs and alterations and advises the Secretary as to whether the work in the various bureaus is being co-ordinated and expedited. The Aid for Personnel keeps posted as to the officers and men, and is always in touch with conditions at Annapolis and the training stations.

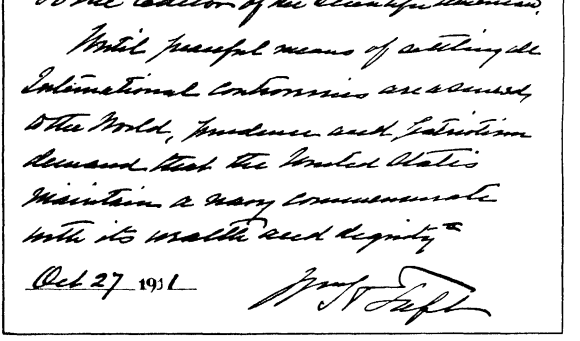
The Division of Inspections, reporting direct to the Secretary, co-operates with the Division of Material in finding out the condition of the ships and the necessity for repairs, and advises also as to whether repairs and alterations requested will be worth the expenditure of money in final military value. A part of this work was formerly done by the Board on Construction, composed of the individual bureau chiefs Under this board also came the final determination of the qualities of new ships In the present organization, the designs and general military characteristics of ships are determined in a more rational and up-to-date manner The general military features required are recommended by the General Board and are referred to the Bureau of Construction and Repair In case the general requirements asked for cannot be met, they are modified or changed to suit what may be accomplished on a given displacement After the sketch plans are ready, sea-going officers from the fleet and other sources go over these designs, criticise and suggest improvements The modified requirements go back to the Bureau of Construction and Repair for change in the outline plans, which are again submitted to scrutiny. The whole matter has thus been thoroughly gone over and the objections, criticisms and suggestions of the sea-going officers, and the opinions and knowledge of the technical officers have been assimilated. The final designs represent both the best technical knowledge and the sea-going experience of our expert officers. The best naval advice is now placed in the hands of the designer without his efforts being required to reconcile many conflicting opinions, and at the same time the officer who will have to fight the ship finds that his advice is not ignored This method has proved an inspiration to the naval architect, and the present designs of battleships are far in advance of all former attempts.

The Department has been for some time studying the new systems of modern management in commercial establishments, both in this country and in England, with a view to introducing such parts or features of it as might be applicable to our navy yards. Civilian experts who visited the vessels of the fleet found that the highest type of scientific management now exists in our battleships, and they have expressed to me the greatest admiration for the progress so far made and the excellent results accomplished. They found the Office of the Director of Target Practice a fine example of a planning office.

Some form of central planning will probably be added to the present organization, shop methods will be improved, and better determination of the use of machine tools and the efforts of the individual workman will be sought. The Department hopes to secure the best features of successful management and adapt them to navy yard requirements, thus cutting out wastes in time and by better methods securing increased production, with mutual benefit to the government and the workmen If the energy of the workmen is wasted or is not efficiently applied, the elimination of the conditions producing such waste of good energy would be beneficial alike to the government and its employees; for both should share in the benefits of increased production

The Division of Operations has drawn up a new organization for the fleet, to consist of 21 battleships, assigning one to the Commander-in-Chief, leaving five ships in each of the four divisions of the battle fleet But one ship of each division will be at a navy yard for general repair, the other ships coming to the yards only for docking or minor emergency repairs twice each year The efforts to make the ships as self-sustaining as possible have been encouraged, with the result that the work at the navy yards has been reduced The carrying out of these two business-like features in handling the fleet will show more clearly the wisdom of recommendations made last fall that we give up a number of our smaller and unrequired navy yards

One of the chief causes of great expenditures in the Navy is the excessive number of navy yards We have on the Atlantic Coast nine navy yards, where in several instances, money has been expended lavishly, which would not have been the case if the strategic and economic point of view only had been considered



LETTER FROM PRESIDENT TAFT, COMMANDER-IN-CHIEF OF THE UNITED STATES NAVY

Last year, as a beginning, it was recommended to Congress that several stations be abolished which would have brought about a saving, irrespective of the price which the government might have obtained for these properties, of an annual maintenance expense of $1,600,000.

Criticism has been made for my not having recommended the abolishment of any of the Eastern yards, but the reason was that, for the present, the dry docks in the Eastern yards are a necessity to the fleet. The Eastern yards are located at Portsmouth, Boston, New York, Philadelphia and Norfolk, and it might be well to include Charleston. It has been sometimes stated that not more than three or four of these navy yards will be actually necessary, preserving, however, the use of all the large docks for government purposes The question as to which of these yards should be maintained and which abolished is so important that it should be thoroughly considered by an unbiased board of experts, having in mind not local interests but only those of the fleet; as the yards exist for the fleet and not the fleet for the yards As navy yards have no defensive facilities, the army must be consulted as to their protection and defense, consequently, the consideration as to which of these six yards are necessary to the navy from an economic and strategic point of view has been left to a joint Army and Navy Board to determine On their report will be based my recommendations to the President as to the necessity of these yards, and as to which should be developed and continued

When the Panama Canal opens, and the fleet spends probably an equal amount of time in each ocean, the work for the Atlantic yards will be much reduced and it will be even more evident that fewer will be needed By a proper reduction in navy yards, there would be a vast saving of money in maintenance, probably three to four millions a year, and a realization of funds from the sale of real estate If this is not done Congress must assume the responsibility The great importance of the Caribbean Sea as a base of future naval operations, consequent on the completion of the Panama Canal, is now well realized It is the plan of the department to have a naval base in the accessible and suitable harbor of Guantanamo, Cuba, on the direct route to Panama, which is some 700 miles from the Canal, and capable of harboring a fleet of 50 or more men-of-war With a fortified entrance to the canal, a reasonably strong base at Guantanamo, and a torpedo base at Key West, our fleet will be able to utilize its full strength for attack or defense in the Caribbean, and the Gulf of Mexico will be as safe as an inland lake

It is important, during battle maneuvers in peace, or a period of real hostilities, that a vessel should not be called upon to return thousands of miles in order to effect urgent repairs These can be more easily and economically done by the development of Guantanamo as a limited docking and repair station

It is the intention to develop Pearl Harbor, San Francisco Bay, and Puget Sound in order that the entire fleet may be maintained at times on the Pacific Coast

The Department has been working for some time with the President's Commission on Economy and Efficiency toward introducing better business methods in correspondence purchases and other details within the Department itself The introduction of more economical methods in the departments and at navy yards will be facilitated by the new system of accounting which has been established within the last year in the Department and at the navy yards It is now possible to get accurate trial balances, follow the cost of work, and determine with a larger degree of accuracy just what the navy's money is being spent for

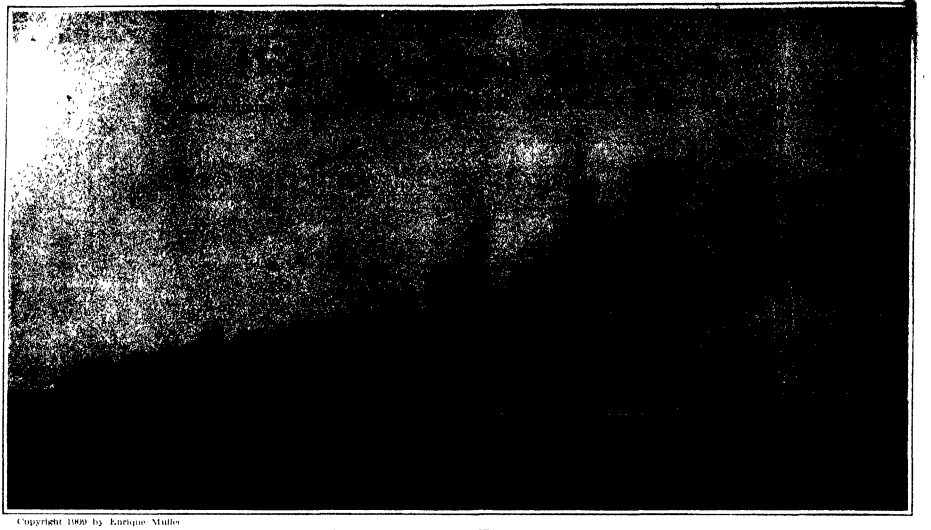
It is proposed, also, to reduce to the smallest limits the number of articles manufactured in navy yards, and to buy in open competition, whenever possible, all articles which can be properly and more cheaply made by commercial establishments Naval specifications have recently been simplified and conform more to commercial usage, thus resulting in increased competition and lower prices to the Navy

The occasional building of a battleship or vessel of a special class in a government yard, in order to demonstrate cost, is valuable and instructive, but should be avoided when a large saving ($1,500,000 on a single battleship) can be made On account of the restriction made by Congress in the Naval Act of June 24th, 1910, by which it was provided that one of the battleships therein authorized must be constructed in a government yard, this saving can not be effected

The question of docks for our larger vessels has been, until lately, a serious one It looked for some time as if our latest ships such as the "Arkansas" and "Wyoming," would be finished before any dock would be available to clean their bottoms and have them ready for their trial trips To provide against this, vigorous action was necessary and was taken

Dry Dock No 4, at the Brooklyn Navy Yard, will now be completed in January, 1912, and Dry Dock No 3, at Norfolk, lengthened to 700 feet, was finished in September, 1911 The Pearl Harbor dock and the large dock at Puget Sound, which will accommodate ships of the "Wyoming" class, are being pushed, and the latter is expected to be ready in March, 1912.

(Continued on page 517)



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PRE-DREADNOUGHT SHIPS OF THE ATLANTIC FLEET STEAMING IN COLUMN

THE strength of the fleet is commonly measured by the number of battleships and other fighting units on the Navy List. In a way this is correct and yet it may lead to serious error. It is safer to regard the number of battleships, armored cruisers, scouts, destroyers, etc., as only the potential strength, since the efficiency of the fleet, its ability to proceed promptly where needed and engage and overcome an enemy, depends upon many other things than mere ships.

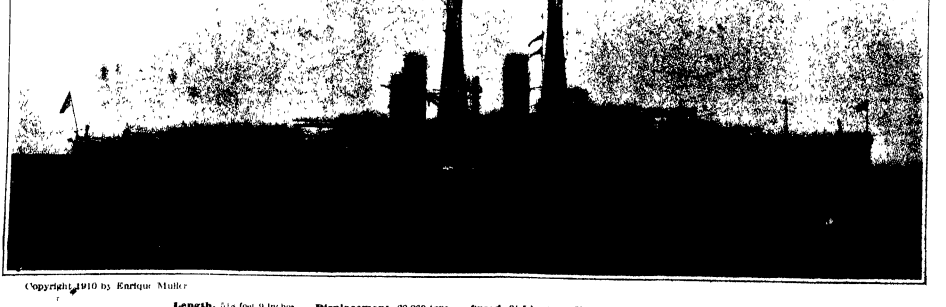
It is pertinent to remind the reader that battleships and even the guns they carry, require years to build, that fighting ships can no longer be built or improvised after the outbreak of war that officers and men can no longer be recruited from the merchant marine and quickly converted into naval crews, and therefore a nation to be ready for war must prepare in time of peace, and if not prepared can have small hope of victory over an enemy more wisely administered. The parable of the wise and foolish virgins is nowhere more applicable than with a naval force. These facts are so often lost to sight, even by many in high places, that it is well to mention them here as a preamble to a discussion which would not be understood or if understood would fail to carry conviction, if they were not borne in mind.

The numerical strength of our fleet, as compared with other leading naval powers, is shown in the tables on page 532.

For several years past only about sixteen battleships have been kept in active service, the remaining vessels of this class together with a number of ships of less importance, being out of commission for overhauling or in reserve for want of a sufficient number of officers and enlisted men to man them. On July 1st, 1911, the battleships in full commission were increased to twenty and shortly afterward to twenty one, while all battleships built, thirty-one in number, will, about the end of this year, be either in full commission, or in reserve with sufficiently large crews to keep them in readiness for service. This great increase in the strength of the fleet is best shown by a comparison of the number of battleships and armored cruisers that were in full commission or in reserve, ready for active service, on May 1st 1910, and the number that will be in readiness about the end of this year, when the reorganization of the fleet being effected by Secretary Meyer will have been fully realized. A similar increase in the effective torpedo fleet, and to a less extent other vessels, has been made, but the most significant fact is of course the increase from 19 to 31 battleships in condition for active service as regards material. A second and no less significant fact is that this large fleet is being created and maintained at a less cost for the entire naval establishment than formerly. The reasons for this are numerous, but the most important may be briefly stated here.

	May 1 1910	Dec 31 1911
Battleships in active service...	16	21
Battleships in reserve, ready for service	3	10
Armored cruisers in active service	10	8
Armored cruisers in reserve	0	2

The most valuable lesson learned from the voyage of the battleship fleet around the world in 1908-1909 was that naval vessels may be practically self-sustaining in matters of repairs, provided the personnel is of a high standard. This fact is the basis of the reorganization lately put into effect, which makes possible the maintenance of the entire fleet in readiness for service. Before the reorganization it was customary to employ ships' crews to only a comparatively small extent in repair work. Vessels once placed in commission were habitually kept actively employed, with frequent visits to the navy yards for necessary repairs, until they deteriorated to such an extent as to require an extensive overhaul, when they were placed out of commission and turned over to the navy yard forces. During their period of commission



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Length, 518 feet 9 inches. **Displacement,** 22,060 tons. **Speed,** 21.5 knots. **Maximum Coal Supply,** 2,670 tons
Armament, ten 12-inch, fourteen 5-inch. **Armor:** belt, 12-inch, turrets, 12-inch. **Complement,** 938 officers and men

U. S. S. "DELAWARE." THIS TYPE WITH CENTER-LINE TURRETS HAS BECOME STANDARD IN THE WORLD'S NAVIES

major repair work not deemed of immediate importance were permitted to accumulate. This practice resulted in the ships not being in the best condition during the latter part of their commission, in expensive navy yard repairs during their active service; in extremely high cost of general overhaul and refitting after being placed out of commission; and, what is of the greatest importance of all from the viewpoint of preparedness, in the loss of ships to the Navy for anywhere from two to five years during their period of overhaul. In short, the old methods were extremely inefficient and wasteful. Under the system lately adopted ships will not be placed out of commission until they become obsolete and useless for war purposes. They are kept in efficient condition by their own crews and the navy yard work on them is limited to that clearly beyond the capacity of the crews.

The battle fleet is organized in divisions. Each division contains five ships of like or nearly similar tactical qualities. Four ships are required to be ready for service, while the fifth ship is allowed to lie at its home yard for overhauling and repairs by the crew, assisted as far as necessary by the yard force. The ships of a division are given this overhaul period in rotation, or each has about two months' uninterrupted time for repairs once each year. The net result of this is that in a fleet of twenty ships, sixteen are kept ready for service, and the remaining four are in a condition nearly approaching readiness.

Repair work done at a navy yard is very expensive and generally is not of better quality, if as good, as work done by a ship's force. Obviously the difference in cost is very greatly in favor of the ship's force, since the pay of the naval personnel is the same, whether it does the work or stands by and watches the navy yard force do it. As a general rule no one can know the needs of a ship as well as her officers and crew, and no other set of men is as capable as they of doing their ordinary repair work efficiently and economically. But, aside from these considerations, it is essential from a military point of view that the ships' officers and crews shall be habituated to this work in order that they may be able to maintain the fleet in an efficient condition in time of war, when there may be no navy yards at hand. Furthermore, of equal importance is the fact that ships may be kept in practically constant readiness for battle when repairs are habitually taken in hand and completed as rapidly as the necessity arises, while, if a navy yard is depended upon, repairs are allowed to accumulate, and when taken up by the yard require much time to complete.

As stated before, the strength of the fleet and its readiness for service depends upon many other things than mere ships. One of the most important factors is that of keeping all the units in readiness as regards material, as was dwelt upon somewhat at length in the preceding paragraphs, and a second fundamental requirement is that the personnel, both officers and men, must be competent and zealous in their work. Given these two fundamentals, there remain, before the fleet can be called efficient, the constant training of officers and men in their duties, the maintenance of a high *morale*, the inculcation of habits of high moral, physical and mental discipline, the attainment of the highest possible efficiency in gunnery and engineering; and finally, the amalgamation of all the units of the fleet into a composite whole capable of responding to the will of a practised commander-in-chief.

The question as to whether the fleet now meets these conditions and requirements depends upon what are regarded as the standards of efficiency and readiness. In matters of naval preparedness and efficiency the strength of a fleet is ordinarily measured by comparison with those of foreign powers. This method often leads to erroneous conclusions, for, as history shows, the true strength of a fleet can never be accurately determined except by the supreme test of war. The method that tends to the highest state of efficiency is to keep before us a standard of perfection, which if impossible, leads ever to constant improvement.

One of the most potent factors for steady improvement is competition, and to it much of our present efficiency in gunnery and engineering may be attributed. The spirit of competition not only leads to constant efforts on the part of the personnel to excel with the instruments placed in its hands, but stimulates the inventive genius of those charged with the making of the instruments, so that there has been a continual advance in the power and accuracy of guns as well as in the rapidity and expertness of their use. This is exemplified by the remarkable improvement in our gunnery since the Spanish-American war. At that time our fighting range was only two to four thousand yards, and a twelve or thirteen inch gun was fired once in about three minutes, now, our target practice is carried out at a range of ten to twelve thousand yards, and the heavy guns fire two shots per minute, and with this advance in range and rapidity there has been a still more remarkable improvement in accuracy.

The advance in engineering efficiency has been as striking, and almost, if not quite, as important as the advance in gunnery. The reliability of the engines, as shown by full speed trials immediately after long cruisers, is of vital importance, and skill in fitting, with attention to other details, has increased the steaming radius of the fleet from 25 to 40 per cent.

The cruise of the battleship fleet around the world did more than any other one thing to mold our fleet into shape; before that time the fleet may be said to have been an aggregation of units, but the cruise, with its attendant constant exercise in fleet tactics, made these units into one machine-like body. In short the fleet on this cruise found itself. Since then more than ever before, attention has been given to tactical and battle exercises, frequently under conditions simulating war. This more than anything else, except gunnery proficiency, insures readiness for battle. Even the best of ships would meet defeat if incapable of being handled effectively as a fleet.

Twice each year the battleship fleet, the torpedo fleet, and all other vessels available, are concentrated for joint maneuvers and battle exercises under the direction of the commander-in-chief, who thus gains the experience and practice necessary for his final training in the art of war. At other times each year the commanders of divisions of the fleet are given the opportunity to cruise and exercise their commands independently in order to gain experience which will fit them for succession to the command of a fleet.

As previously mentioned, those battleships and other vessels which cannot be kept in full commission, owing to a lack of available men, and to the considerable increase of cost involved, are being organized into a reserve fleet which, as far as their material condition is concerned, will be at all times ready for active service. These vessels are being provided with reduced crews to keep them in condition, and to serve as a nucleus of the full crews which, in the event of war, will be made up from the officers and men employed in time of peace at the shore stations, from the naval militia, and by the re-enlistment of men of previous naval training. This is a long step in advance in the matter of preparedness over the conditions which formerly existed.

The principal requirements of the fleet at present, without considering any increase in its battleship strength, are:

(1) The gradual replacing of worn out or obsolete vessels by newly-constructed ships designed to efficiently meet the needs of the service.

(2) The provision of additional auxiliary vessels, repair ships, supply ships, colliers, tenders to torpedo fleets, tenders to submarines, transports and hospital ships.

(3) Additional scout cruisers, destroyers and submarines.

(4) The organization of an adequate naval reserve.

Battleships have a useful life of about twenty years, during the first half of which they may be considered eligible for the first line, or the main battle fleet, and during the latter half for the second line, or reserve fleet. The comparatively short life of ships is due not so much to deterioration as to the rapidity of development of science and the arts, which renders ships obsolete after ten to twenty years. As a case in point, compare battleships of the "Oregon" class with those of the "Delaware" class, the former launched in 1893 and the latter in 1909. There is not the slightest doubt that one "Delaware" could defeat in action a whole division of "Oregons," or could destroy the entire American fleet of the Spanish-American war. Thus it becomes necessary to replace these obsolete vessels and to relegate them to the coast defense and finally to "scrap" them, use them as targets, or otherwise dispose of them to the best advantage.

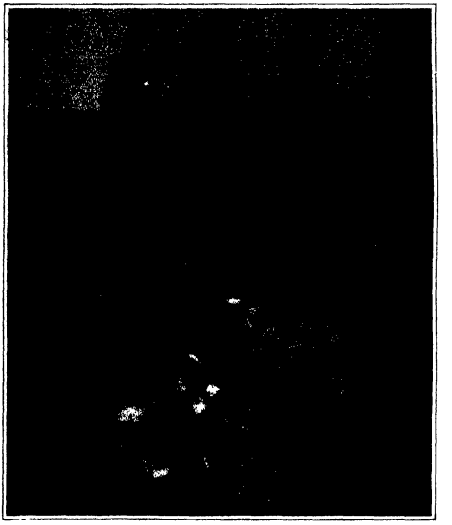
Auxiliary vessels are absolutely necessary for the maintenance of a battle fleet. Some such vessels have been provided, and additional ones must be obtained from the merchant marine when war becomes imminent. In this connection our merchant marine is deplorably small and therefore the Navy must be provided with a larger number of regular naval auxiliaries than would be necessary or desirable if enough merchant ships were available.

The necessity for additional scout cruisers of which we possess only three built for that specific use, destroyers and submarines, is apparent from an examination of the tables on page 542 showing the fleets of the several powers. A battleship is dependent largely upon its scouts and destroyers for protection against torpedo attack as well as for the discovery of and attack on the enemy's fleet.

The creation of a naval reserve of officers and men is urgently necessary. The reserve should be composed of men who have had experience on board naval vessels. Thousands of such men pass each year from the Navy into civil life, and while it is expected that a large proportion of them will re-enlist in a national emergency, they should be formed into a reserve in time of peace, so organized that in an emergency they could be assembled at appropriate rendezvous and the reserve fleet manned without undue and possibly fatal delay.

Finally, the whole nation must be awake to the necessity of naval preparedness as a preventive of war. It has been well said that our nation is warlike but not a military one. History bears this out, and it is a fact that all our wars have cost us excessively in life and money because of our unreadiness. Wars are usually of short duration, but preparation is long, and under modern conditions adequate preparation after war breaks out is well-nigh impossible. Our nation leads all others in its advocacy of arbitration. Our propositions are received with respect because of our strength, both actual and potential. To day our interests touch with those of other nations in all parts of the globe, and while good faith and high principles have greater world force than ever, the time has yet to arrive when our national policy, even our national safety, can be held secure without armed forces, and of these an efficient battle fleet is indispensable.

(Continued on page 532.)



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The operations of a fleet are directed mainly by signals from the bridge of the flagship. In the above photograph, at the end of the bridge is seen a semaphore, and above the rail is a signalman with two flags, each of these sends "wig-wag" signals. The signal officer and a signalman are at the rail reading signals from another ship through telescopes.

THE SIGNAL BRIDGE OF A BATTLESHIP

Influence of the United States on the World's Battleship Design

Our Plan of Placing All Turrets on the Center-line Has Become the World's Standard

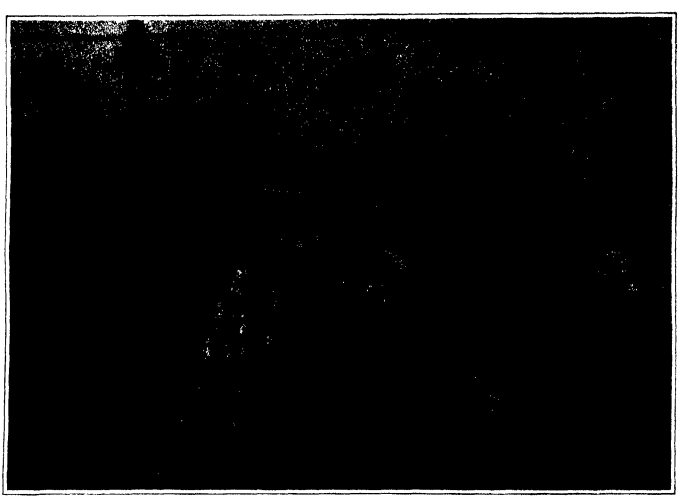
By Rear-Admiral R. M. Watt, U. S. N., Chief Constructor and Chief of Bureau of Construction and Repair

IT is a well known engineering principle that any design of the first magnitude must be a development of previous practice and based on features gathered from the four corners of the technical world To attempt to trace the origin of many of these features would be a task for a historian and the result would be of small value except as a matter of academic interest In a broad way, however, the history of shipbuilding and designing in the United States shows numerous fields in which Americans have been pioneers or instruments in the highest development of the ideas of others

The well known inventive genius of the American can be recognized as a basic influence in myriad mechanical details incorporated in the great ships of war or peace of all the maritime nations These details though great in their final result, cannot be considered as a direct influence on the design of the individual ship This influence, however, can be found even in the early history of this country when the American clipper ship was the fleetest sailer on all the seven seas From this point to the present day the same influence can be traced through such great events as the marine application of the steam engine, the development of the armored revolving turret for the mounting of heavy guns, the application of electricity to all auxiliary power purposes on board ship, the appearance of the American type of the modern submarine which, in its original form or as a basis for further development, is found today in the navies of England, Japan and Russia, the introduction on war vessels of the many comforts and conveniences of modern life, thereby permitting the fighting personnel to be maintained in the highest state of physical and mental training These and many others are features which, through internal and external sources have influenced, by the agency of American designers, the present-day development of that great fighting machine, the battleship In the consideration of this type it is well to pass over the great events of previous years and the details of today and treat only of those features which, to the naval architect, give a ship an individuality of its own Such a feature is what is now generally known as the "American turret arrangement which it will be interesting to examine in some detail

A battleship has frequently been described as a machine whose output is fighting capacity In the development of any new type of machine, one designer will emphasize some one feature or arrangement, while other designers considering other features of greater importance will make collateral provision for them With the advance of time and increased experience there is a gradual adoption of a standard type of machine, to which all manufacturers more or less conform It is the purpose of this paper to show that the designers of the war vessels of the United States *in their first all-big-gun battleship* adopted as the emphasized feature of the fighting machine a battery arrangement which, after experiment with various other battery arrangements, is now generally accepted by the designers of all nations as the standard battery arrangement (of guns) for the all big-gun battleship In thus setting the standard battery arrangement of fighting vessels, the influence of the United States on the world's battleship design *cannot be overestimated*

The armament—that is the guns upon the number and arrangement of which fighting capacity depends—is the most striking feature of a battleship. In the development of the all big-gun battleship, the designers of the United States naval vessels at once adopted an arrangement of all turrets on the center-line of the vessel whereby at the forward end of the vessel number two turret fired over number one turret and at the after end of the vessel number three turret fired over number four turret In this manner all guns were enabled to fire on each broadside, and naval authorities are practically agreed that not less than 85 per cent of the firing will take place in the arc forty-five degrees forward and forty-five degrees abaft the beam This arrangement was adopted in 1906 by the United States in its first all big-gun vessels, the 'South Carolina,' and 'Michigan,' and the all-turrets-on-center-line arrangement has been followed in all battleship designs for the U S Navy since that date.



All the turrets of our later battleships are located on the longitudinal center line of the ships. This enables every big gun to be trained through a wide arc of fire on either broadside.

THE THREE AFTER TURRETS OF THE "NORTH DAKOTA"

Assigning what we considered undue importance to end-on fire, foreign designers adopted arrangements which gave them end-on fire by the sacrifice of broadside fire to such an extent that from twenty to thirty and more per cent of guns could not be fired on the broadside, where they would most often be required. It should be noted that every battleship of the all-big-gun type in the U S. Navy can fight every gun on the broadside—a provision which does not obtain in any other navy of the world

To-day, however, the wisdom of the "South Carolina" arrangement is generally recognized, and such arrangement is coming into general use in all armored vessel construction

That the importance of the principle of center-line turrets is not merely the view of an interested American naval officer is proven by the following foreign comments

In a paper on "The Armaments of Battleship," contributed by that pre-eminent naval architect, Sir William White, to the American Society of Naval Architects and Marine Engineers in November, 1910, he wrote

"There are two positions for heavy guns which by common consent confer supreme advantages, and are always utilized. These positions are at the center line of the deck; one commanding right-ahead fire, with large arcs of horizontal training reaching well abaft the beam on each side, the other possessing corresponding command right astern and over large arcs of training reaching well before the beam. Until the 'Michigan' and 'South Carolina' were designed it was the general practice to mount one or two heavy guns—two in nearly all cases—in each of these positions. Superposed turrets were tried in some cases, and 8-inch guns were mounted in the upper emplacement; but this practice did not find much favor and may be considered to have dropped out of use. It was a new and bold departure in the 'Michigan' and 'South Carolina' to place two turrets in each of the supreme positions and to arrange for firing the guns in one turret over the top of the other turret. That arrangement proved successful, however, and has been largely adopted in recent ships of all navies When associated with the mounting of guns in pairs this system permits the effective use of eight heavy guns, if three guns are mounted in each turret then twelve heavy guns can be given equal arcs of command, and all the guns can be used on each broadside . . .

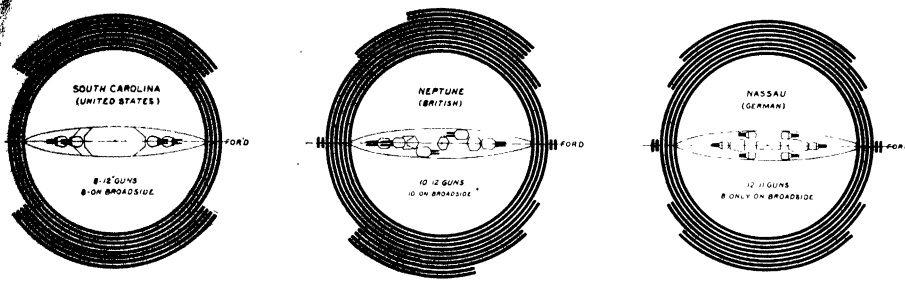
"Now there is a marked disposition to place all the heavy-gun stations at the center line of the deck, so that all the guns may be available on both broadsides This is a return to a disposition adopted in the earliest British turret ships built nearly half a century ago. The 'Royal Sovereign' (1863) and the 'Prince Albert' which followed immediately after her, each had four turrets so placed. It may be noted that the United States Navy took the stand in this last movement, and further has the credit of demonstrating the possibility of associating powerful bow and stern fire with the maximum of broadside fire over large arcs of training, by placing some turrets higher than other and firing over the lower turrets on certain bearings"

In commenting on the above paper by Sir William White, *The Engineer*, published in London, says editorially in its issue of December 2nd, 1910:

"In tonnage value for effect obtainable, it is hard to believe that it is possible to improve on the arrangement, first adopted in the United States battleship 'Michigan,' of four twin turrets on the center line, the two inner turrets firing over the two end turrets."

In its annual comments on warship design, "The Naval Annual" for 1910, edited by Lord Brassey, says:

" . . . . The 'Michigan' and 'South Carolina,' of 16,000 tons, have a speed of nearly 19 knots and eight 12-inch guns, all mounted in pairs on the center line, the second and third turrets being on a higher plane than those at the extremities of the vessel, so as to allow of their guns pointing over the end turrets, enabling four guns to be directed right ahead and astern. Now, if they can be so fired without detriment to the outer gun positions, the design possesses the advantage that, with two guns less than our 'Dreadnought,' an equal broadside fire is secured. It only gives, however, an end-on fire of four guns against six. Another novelty in the 'Michigan' and



The eight-gun "South Carolina" of 16,000 tons can deliver a more effective broadside than the twelve-gun "Nassau" of 18,500 tons displacement

is the means whereby elevation is secured for observation, signalling, etc. Masts in some form are required. The tripod method was adopted in the 'Dreadnought.' It is not novel, having been advocated by Cowper Coles and applied to the 'Captain' for sailing purposes It gave less interference with turret-gun fire than ordinary rigging But the three iron masts forming the tripod are of great weight, and probably mainly on this account the Americans have, in the 'Michigan,' placed two masts constructed like an Eiffel Tower of steel lattice work. Though offering a comparatively large target, presumably it is expected that projectiles will pass through without doing great damage; but if the resistance is sufficient to explode a shell a different result may follow"

Jane's "Fighting Ships" for 1907, said

"There is some good reason to believe that taking all things into consideration the 'South Carolina' type is the best all-big-gun ship yet put in hand"

Jane's "Fighting Ships" for 1908, referring to center-line battery arrangement, says

"The disposition of artillery in the 'Delaware' is peculiar, all turrets being in the center line There is little doubt that this design is superior to the echelon system in the matter of training The British 'Invincible' class, though nominally able to bear all eight guns on either broadside, can only do so over a very limited arc of training, while every 'Delaware' turret has a fine arc on either side."

And again in 1910, on page 503 of Jane's "Fighting Ships," Captain William Hovgaard states

"The ideal arrangement of the heavy gun-turrets seems to be the American, first adopted in the 'Michigan,' where two turrets are placed at each end of the ship in the center line, the guns nearest amidships firing over those nearest the ends By this disposition the guns obtain the maximum arc of fire, the position of the upper turrets is commanding and dry, the arrangement of ammunition rooms is simple, and ample room is left amidships for an efficient and well protected secondary and anti-torpedo boat battery With turrets placed on the broadside or on a low level in the center-line between end turrets, these advantages will not be obtained, and notably the relative loss in arc of fire, as in case of the broadside turrets of the 'Dreadnought,' the 'Nassau,' and the new French 23,000 ton battleship, will very considerably reduce the efficiency of the guns

"If then we want to increase the power of the primary battery beyond that obtainable with the 'Michigan' arrangement, and without abandoning the said advantages, three ways are open

"(a) A third twin-turret may be placed on the center-line at each end of the ship inside the two other turrets and firing over these

"(b) The caliber of the guns may be increased

"(c) Three guns may be mounted in each turret"

Commenting on the visit of the United States fleet to Europe, the *Journal of the Royal United Service Institution* for December, 1910, states

"It may be of interest to recall that the two American dreadnought battleships, the 'Delaware' and 'North Dakota,' are vessels with a displacement of 20,000 tons, and in addition to their main battery, composed, like that of our own earlier dreadnoughts, of ten 12-inch 45 caliber guns, they also carry a more powerful anti-torpedo defence armament of fourteen 5-inch Q F guns, which for the most part are mounted in a central battery behind armor protection All the big guns are on the center line of the ship, this being a characteristic feature of the turret arrangements in American designs, two of the turrets being raised above the others in order to obtain a sufficiency of right ahead and right astern fire and this method of placing the turrets in the one now adopted for our latest ships, as giving the advantage that all the guns can be fired on either broadside Thus, while the 'Dakota' and 'Delaware' can bring all ten of their 12-inch guns to bear on either side, our earlier dreadnoughts including the 'St Vincent' and her sisters, can only bring eight On the other hand, the end-on fire of our ships is heavier"

It should be noted that the *same* arrangement of the turrets of the 'South Carolina' and 'Michigan' was not the result of chance, but was adopted only after actual experiments on the monitor "Tallahassee" (then the "Florida") had proven that it was possible to fire a 12-inch gun over a turret without injury to the occupants of the lower turret It is believed that the battery arrangement of the "South Carolina" and "Michigan" will remain a standard arrangement in the future, and that further increases in fighting capacity will be secured by increasing the caliber of guns, or by increasing the number of guns in a turret, or by both measures in the all-center line vertical echelon turret arrangement

The Business Management of the Navy

(Continued from page 513)

The width of the latest docks has been increased to 110 feet, the same as established in the locks of the Panama Canal

Two contractors having failed to secure results with the New York dock, the second contract was ordered to be cancelled on account of no progress having been made, and competition for the completion of this important work was limited to the six largest firms of recognized engineering ability and financial standing The contract, placed in November, 1909, under these conditions, is being well carried out and the great dock at the New York Navy Yard will be finished in January, 1912

The large dock at the Boston Navy Yard was enlarged slightly, at a cost of only $15,000, so that it now can comfortably dock the 'Florida' and "Utah"

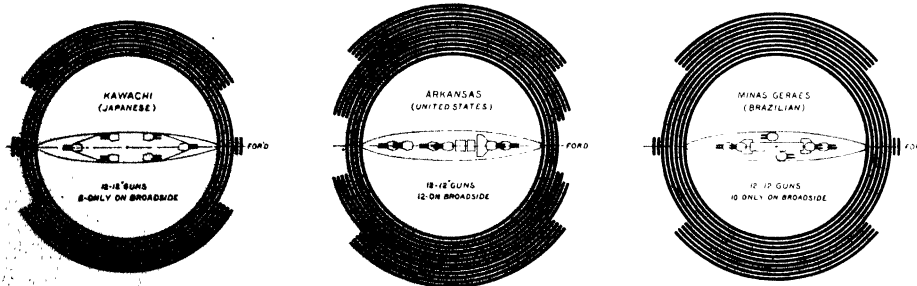
Competition, both in the fleet and at navy yards, has been a great factor in reducing the expenses of a growing fleet The present high standard of shooting is due to the system of competition introduced some ten years ago Comparison between the shooting in 1898 and to-day shows that to-day we are 1,200 times better

Steaming competitions have lately been introduced, so that economy in the use of coal oil, waste, and other supplies, and the efficiency in steaming determine the ships' standing The idea is that a ship must be able, first to get on the battle ground quickly and surely, when she is there, she must be able to shoot rapidly and straight

Instead of having seven store accounts we now have but one, which has simplified book keeping and clerical work The old Naval Supply Fund, which had a capital of $2,700,000 has been liquidated and this sum has been released to the Treasury for other purposes

It is hoped that a correct personnel bill will be secured, by which the ages of our officers may be reduced and greater efficiency brought about The bill recommended will produce captains from 45 to 48 years of age and rear admirals at 55 instead of about 60 It is also desired to add two vice admirals and an admiral, in order that the commander-in-chief of our great battleship fleet should have a position commensurate in importance with his command and that he should not be outranked, when meeting foreign fleets on special occasions, at home and abroad by an admiral of a single ship or of an inferior navy

In conclusion, let me add that the aim of this administration has been to introduce into the management of the navy modern, efficient business methods, to reduce correspondence and cut out red tape Economies have been established and output increased Nor has the department, in its efforts to reduce expenses, forgotten the paramount importance of the highest military efficiency and a preparedness for any emergency. To-day, when needed it holds, to preserve the peace, a larger and more efficient fleet at a smaller cost for upkeep The changes in organization have justified themselves by results and are paying—the final test of all business management



The "Arkansas" can concentrate on the broadside two more guns than the Brazilian "Minas Geraes," and four more than the Japanese "Kawachi."

Propelling Machinery for Naval Vessels

Review of Present Conditions and Future Possibilities in Motive Power

By Rear-Admiral H. I. Cone, U. S. N., Engineer-in-Chief and Chief of Bureau of Steam Engineering

THE advent of the turbine has greatly extended the range of speed at which vessels may be safely and continuously propelled by steam machinery. It is, therefore, particularly suited to high speed vessels.

In the older destroyers a sustained speed of 30 knots necessitated driving the reciprocating engine at or beyond its limit of safety and reliability. As a result the contract speed could rarely be maintained on service, and certainly not for any extended period of time.

To-day the steam turbines of our destroyers can be driven continuously at full power as readily as at the lower powers.

Next below the destroyer in the speed scale is the scout cruiser, of these we have three, the "Birmingham," "Chester" and "Salem," similar in design, except as regards their machinery installations. The "Birmingham" has reciprocating engines, the "Chester," Parsons turbines, and the "Salem" Curtis turbines. The contract trial speeds were: Birmingham, 24.325 knots, "Chester," 26.52 knots, and "Salem," 25.947 knots, thus demonstrating, as in the case of the destroyers, the superiority of the turbine for development of high speed.

A rather unexpected result of our experience with these vessels on service has been the greater reliability of the reciprocating engine. In the case of this type of vessel, where the reciprocating engine is admittedly out of place, it was confidently expected that the turbine would demonstrate its superiority in this regard. Thus far, however, under similar conditions of service, the machinery of the "Birmingham" has required considerably less repairs than that of either turbine vessel, and of the three, the "Birmingham" has always been the one whose availability for service could most be relied upon.

Thus for the scout cruiser, while the turbine is the most suitable type of machinery, its superiority over the reciprocating engine is not so manifest as in the case of the faster destroyer.

As we descend the speed scale into the region of the more important naval vessels of medium speed, the turbine is still less clearly indicated as the best type of propelling engine. This is because of the relatively increased importance of its principal deficiencies which are:

(1) A tendency to disablement to a degree requiring repairs beyond the capacity of the ship's force, thus temporarily destroying the military value of the vessel.

(2) A lack of economy of steam consumption at the lower speeds which affects the cruising radius of the vessel.

Regarding the first of these, there is a tendency to a rubbing and stripping of the turbine blading due to the small clearances necessarily employed, the causes of which are sometimes obscure, and the prevention of which is accordingly difficult.

The reblading of a damaged turbine can be done only at a navy yard, and requires the lifting of the casing and the rotor, which in itself is a considerable item. In our experience this work has seldom been completed within a month.

Improvement in design, greater experience with the operation of the turbine, and better facilities for its repair will doubtless reduce somewhat the extent and importance of this trouble. But at present the reliability of the turbine in service must be considered as probably not as good in a medium or low speed vessel as that of the reciprocating engine in its present development, with forced lubrication of its bearings.

Inferiority of the turbine in its economy at the lower speeds is probably inherent. At the cruising speed of a battleship the reciprocating engine is 20 to 30 per cent more efficient than the turbine.

These failings of the turbine are due in a great degree to the conditions governing its use in naval vessels, and are not manifest in its other applications. When driven continuously at high-speed, as with electric generators, and, to a less degree, in high-speed passenger vessels, its efficiency as compared with that of the reciprocating engine is entirely satisfactory, and in a vessel the nature of whose service is such that the turbines can be kept warm during the short intervals between runs the danger of stripping during the warming-up period largely disappears. The irregular movements of naval vessels however with their frequent periods in port with cold turbines and their considerable cruising at low speeds impose handicaps on the turbine in these two respects.

The peripheral speed of turbines for maximum efficiency should be not less than half the velocity of the steam. To secure this maximum efficiency within practicable limits of diameter of the turbine requires, ordinarily, revolutions per minute of from 1,500 to 3,000. These speeds are perfectly practicable for electric generators, but are unsuited to the marine propeller, whose efficient working requires revolutions, depending upon its diameter, of from 70 to 800 per minute.

There is presented, therefore, the problem of providing a method in which a high-speed turbine may be made to drive a slowly revolving propeller, thus conserving both turbine and propeller efficiencies.

Two methods of accomplishing this are particularly prominent just now.

Reduction-Gear Drive.

The collier "Neptune," built by the Maryland Steel Company at Sparrow's Point, Maryland, has been equipped with reduction-gear machinery constructed by the Westinghouse Machine Company. This collier is a twin-screw vessel, displacing 19,300 tons, with a



The turbines, shafting and propellers of a triple-screw destroyer, assembled in the shops.

speed of 14 knots. Steam at a pressure of 200 pounds is supplied to a Westinghouse Parsons turbine for each shaft, each turbine developing about 3,600 shaft horse power on 1,220 revolutions. Between the turbine and its propeller shaft is mechanical gearing which will reduce the propeller speed to 135 revolutions per minute at about 14 knots. The gear pinions are carried in floating frames supported by oil pistons in such manner as to effectually take up any irregularity in the gear cutting. The oil pressure on pistons is indicated on gages which afford a means of directly reading the tooth pressure, and thus calculating the power being developed. A novel feature of the installation is a provision for operating the propelling machinery from the bridge. The shop tests of the gearing for the "Neptune" have been very satisfactory. The gears have demonstrated an efficiency of transmission in excess of 98 per cent, and have run quietly for long periods with no apparent wear. There is no back lash on reversing.

Extensive trials of the "Neptune" will be held.

Reduction gearing as installed in the cargo steamer "Vespasian" by the Parsons Company has successfully completed a year's trial, during which its durability has been tested under the severe conditions of weather in the North Sea during the winter months. The vessel has made 32 trips, a total of about 20,000 miles, carrying coal from the Tyne to the Continent and returning with water ballast. It is reported that during this time there has been no appreciable wear in the teeth of the gearing, and that there is practically no slackness apparent, although no provision was made of adjustment for wear. A noticeable feature of the installation has been the almost entire suppression of the tendency to racing of the engine, even in weather when the propeller has been entirely out of water.

Electric Propulsion in a Naval Collier.

In the naval collier "Jupiter," a vessel similar to the "Neptune," which is being constructed at the navy yard, Mare Island, California, there will be obtained a trial of a method of electric propulsion. A contract for this machinery has been placed with the General Electric Company. In this system it is proposed to install one turbo-generator running at a maximum speed of about 2,000 revolutions per minute, and delivering current with a potential of 2,300 volts to induction motors, one on each propeller shaft. The power from the turbine will be transmitted to the propeller shafts, electrically, with a speed reduction in ratio of 18 to 1. The efficiency of transmission is expected to be about 91 per cent. The water rate for this installation is stated to range from 12.15 pounds per shaft horsepower at 14 knots, to 15.55 pounds at 10 knots.

In the case of a battleship the proposed form of electric drive contemplates two turbo generators driving two motors on each of the two main shafts. This multiplicity of units combined with a pole-changing device on two of the motors, promises an economy close to the maximum at all speeds above 10 knots.

Comparing the electric with the mechanical reduction gear it is at once evident that the latter has the superior efficiency of transmission. In the case, however, of a vessel in which economy at the lower speeds is required, the flexibility of the electric installation, as outlined for a battleship, might overcome this disadvantage.

As with the scout cruisers, we will, therefore, probably have in service three similar colliers with different types of propelling machinery, the "Cyclops" being already in commission with an excellent installation of reciprocating engines, which on trial developed a horse-power on less than 1.5 pounds of coal per hour at full power.

Combination of Turbines with Reciprocating Engines.

The combination of a reciprocating engine working the steam from boiler pressure down to nearly atmospheric pressure, and a turbine which works from the exhaust pressure of the reciprocating engine down to the vacuum, is a particularly efficient one, because under such conditions each engine is working in the pressure range to which it is best suited. Such combinations are used with great success in power plants on shore and in certain moderate-speed passenger vessels, notably the "Olympic," "Titanic," "Laurentic," and "Otaki." Its principal value is in economy of steam consumption at full power in a medium speed vessel, in which case it probably gives a gain in economy over the reciprocating engine or turbine of not less than 10 per cent. In the case of naval vessels whose cruising speed requires only from 1/7 to 1/12 of full power, the advantage of this combination is not so impressive.

There is, however, a combination of reciprocating engine and turbine which has its maximum efficiency at the cruising speed. This consists in the use of a small reciprocating engine in a manner similar to that of the cruising turbine in a Parsons turbine installation. The reciprocating engine, whose size is limited to that required to pass the steam for the designed cruising speed, exhausts through the turbines. At higher speeds the reciprocating engine is disconnected. The weight of the reciprocating engine, and the space required, are less than for the cruising turbines, and it is probable that the engine will be less prone to disablement than the cruising turbine. The principal difficulty involved seems to be the design of the clutch connecting the reciprocating engine with the turbine shaft.

In another combination which suggests itself, and which, theoretically, has about the same efficiency, there is substituted for the reciprocating cruising element a small high-speed turbine connected by reduction gearing to the main turbine shaft.

The selection of machinery for a naval vessel at the present time, therefore, requires a careful consideration of a number of possible types. The line drawings on page 519 show the approximate appearances of systems which have been considered for a battleship.

Heavy-Oil Engine.

It now seems probable that none of the foregoing methods of propelling medium-speed naval vessels,

...which are forms of steam machinery, will endure. This in consequence of the recent remarkable development of heavy-oil engines of the Diesel type in Europe. Hitherto, oil engines have not merited much consideration for large naval vessels on account of the limited power that could be developed in a single cylinder. An installation of any considerable power required a multiplicity of cylinders. Now, however, we are credibly informed that 1,000 horse-power has been developed in a cylinder about 33 inches in diameter with a 40-inch stroke, at 150 revolutions per minute, in a 2-cycle marine type reversible engine. This engine has a speed control that is satisfactory, and an economy of fuel consumption probably twice that of a steam engine. An experimental double-acting marine engine, with three cylinders, of about this same size, has been built to develop 6,000 brake horse-power at 150 revolutions per minute. In the development of the oil engine, the trunk piston is being abandoned and cross-heads and connecting rods used. It will, therefore, resemble the reciprocating steam engine, and our experience with the latter will prepare us for the operating and repairing of the oil engine.

As in the case of all first installations of whatever type, there will probably be disappointments in the first applications of the oil engine in marine propulsion, and it may be that further development of the engine may be found necessary prior to its extensive adoption. However, the superior economy of the oil engine, together with the elimination of the steam boiler and condenser will cause us to be patient in the face of a considerable amount of trouble.

The extent of the adoption of the oil engine by the nations of the world will be largely affected by the supply of oil available. We are in a particularly fortunate position in this respect, producing as we do two-thirds of the world's supply.

Use of Fuel Oil in Place of Coal.

In our new construction we are greatly extending the use of oil in steam vessels. All our new destroyers are oil burners, and it is hoped to extend its use to the larger vessels, including battleships. Some of the advantages of oil as compared with coal are as follows:

With oil an evaporation per pound of fuel greater than with coal in the ratio of about 14 to 9, and per square foot of heating surface in about the ratio of 10 to 8, is obtained. Fuel oil can be taken aboard readily without manual labor and without interruption to the routine of the ship.

Steam for full power in such a vessel can be maintained as readily as for low power. A vessel burning oil is capable of prolonged runs at full speed limited in length only by the supply of fuel. There is no reduction in speed due to dirty fires or to difficulty in trimming coal from remote bunkers.

There are no cinders and the amount of smoke can be controlled.

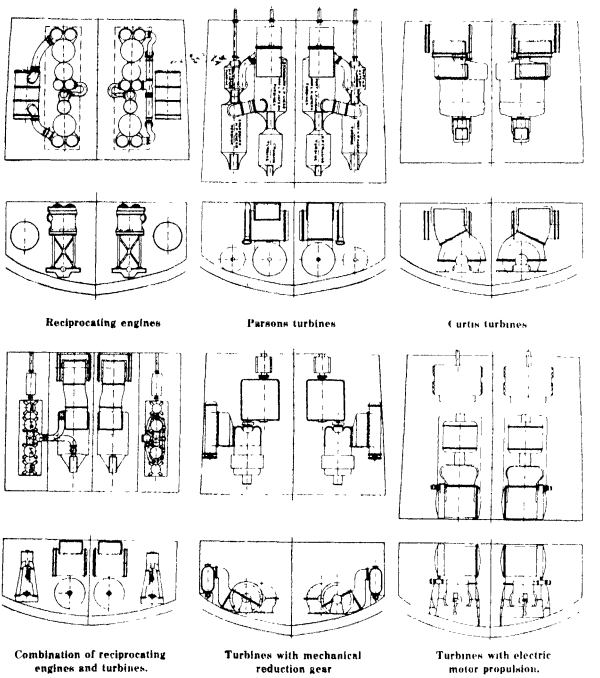
A considerable reduction in personnel is possible, the size of the firemen force required being limited to that necessary for overhaul and cleaning of the plant.

The weight and space required for boilers is reduced first by the reduction in heating surface required and second, by the shortening of firerooms, no space being required in front of boilers for handling the tools.

Coal and ash handling gear is eliminated. This renders unnecessary the piercing of the hull for coal trunks and for discharges from the ash ejectors or ash ejectors.

The stowage and handling of oil is much easier than of coal, and will result in a much cleaner ship and consequent increase in time available for drills.

The mechanical supply of fuel to the boilers gives a prompt and delicate control of the steam supply, permitting more sudden changes in speed than with coal, which is a tactical advantage.

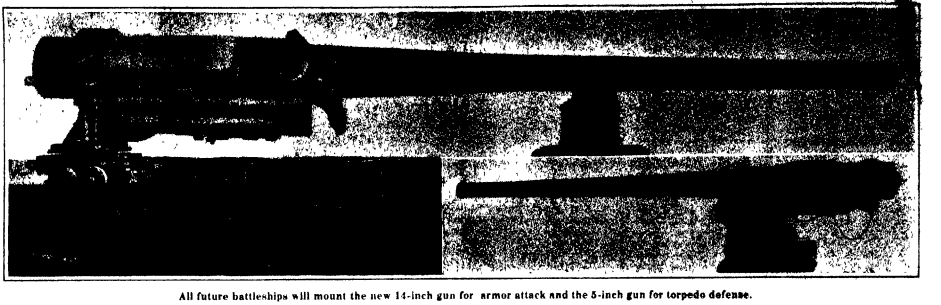


ENGINE ROOMS OF SAME SIZE AS "DELAWARE'S" (RECIPROCATING) EQUIPPED WITH VARIOUS TYPES OF PROPELLING MACHINERY



Speed of turbine, 1,220 revs. per min. Speed of propellers, 135 revs. per min. Efficiency of reduction gear, 98 per cent.

TURBINE AND MECHANICAL REDUCTION GEAR OF THE U. S. COLLIER "NEPTUNE"



All future battleships will mount the new 14-inch gun for armor attack and the 5-inch gun for torpedo defense.

Recent Development in Ordnance

Demand for Higher Efficiency Met by Our Latest Guns and Armor

By Rear-Admiral N. C. Twining, U. S. N., Chief of the Bureau of Ordnance

PROGRESS in ordnance matters during the past year has been rather in the direction of improvement and development of previously existing types than in the line of marked changes. Naval warfare has not been "revolutionized," nor has any such upheaval been even faintly indicated. The increasing efficiency of the submarine boat of the torpedo and of the aeroplane has caused ordnance officials and the navy in general to look ahead to the time when the development of these weapons and methods of attack might demand changes in ordnance or in ship construction to meet them, and tentative plans for such changes have been considered. The aeroplane can not, as yet, be regarded as a material factor in naval warfare, but its possibilities in the future cannot be neglected. The submarine boat and the torpedo have long been elements to be reckoned with, and their usefulness and efficiency are on the increase.

The gun remains the principal offensive weapon afloat and armor the principal element of passive defense. The battle between the two, which has been so often declared lost or won by one or the other, still goes on, though the gun seems to have rather the better of it at the present moment. Already there are rumors of larger and more powerful guns and of armor of greater resisting power. A year ago no modern vessel built or planned carried a gun of caliber greater than thirteen inches, and all of the latest battleships were armed with guns of 12-inch caliber. To-day there are numerous ships building at home and abroad which are designed to carry 13.5-inch and 14-inch guns. Armor's answer to the bigger gun is, so far, increased thickness, but new processes of heat treatment and the introduction of new alloys are rumored, which will restore the former thickness with greater resisting power.

Guns.

The "all-big-gun" battleship of the present day has its prototype in the British "Dreadnought," dating from 1906. Since that date all the principal maritime powers have shown a tendency to confine themselves to battleship design of this type, the main battery consisting of from eight to twelve guns of the largest caliber, mounted in turrets, and the torpedo defense battery of from twelve to twenty or more guns of smaller caliber mounted in broadside.

In the United States Navy the standard heavy gun is at present the 14-inch, 45-caliber gun, while for torpedo defense a 5-inch, 51-caliber gun is used. The following table shows the superiority of these guns over previous types:

Caliber, Inches.	Length in Calibers	Length in Feet.	Weight in Tons	Muzzle Velocity, Feet per Second.	Weight of Shell, Pounds.	Muzzle Energy, Foot Tons	Extreme Range Striking Energy, Foot Tons	Penetration in Krupp Armor, Inches
5	40	17	3 1	2300	50	1692	7000	8 8 at 6000 yds.
5	51	22	5 0	3150	50	3439	12000	8 0 at 6000 yds.
12	45	45	53 6	2650	870	66894	32000	15 8 at 10000 yds.
12	50	50	56 1	2900	870	81644	36000	15 0 at 10000 yds.
14	45	54	63 8	2600	1400	86587	21000	15 9 at 10000 yds.

An examination of this table shows that the latest turret guns and torpedo-defense guns are markedly superior to their predecessors. The superiority of the 10-inch gun over the 12-inch, 50-caliber gun is due in part to the greater steadiness of the projectile in flight due to its greater weight. The "hitting power" of the gun is greater than that of its predecessor in spite of the fact that its extreme range as mounted on board ship is less.

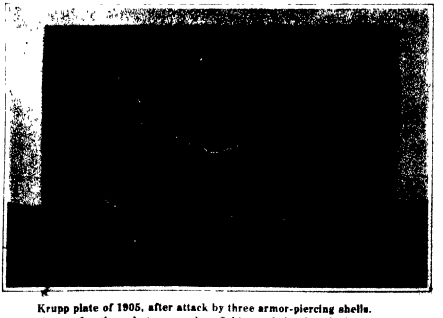
On page 521 are shown the breech and breech-plug of the 14-inch gun, together with an armor piercing shell and powder charge. The shell shown is of the latest "long point" variety, while the powder charge represents the present practice of putting up smokeless powder in silk bags laced on the side to make them rigid. An idea of the length and general size of the 14-inch gun with the slide in which it is mounted in a turret can be gained from the illustration above.

The latest type of gun and mounting for torpedo defense is shown below the 14-inch gun. This gun may be regarded as effective against torpedo boats at its extreme range of 12,000 yards provided the target is visible, at night or in other circumstances rendering the target invisible, the gun is naturally helpless.

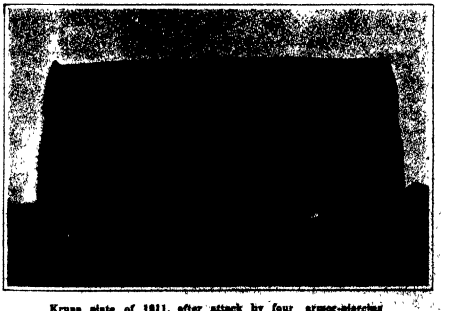
Modern high-powered guns using smokeless powder charges have been proved to have a practically unlimited life under normal conditions of firing, but they erode in the bore very rapidly owing to the high powder pressures they must sustain, and the consequently high temperatures. This erosion is probably due to the action of the powder gases on the metal of the gun as softened by the high temperatures to which it is exposed—about 4,000 deg. F. As the parts of the gun not immediately in contact with the gases suffer no deterioration, the life of the gun may be indefinitely prolonged by renewing the bore. This process is known as "re-lining" and has hitherto consisted in boring out the interior of the gun (to a depth of about one inch in the case of the 12-inch gun) shrinking in a new tube, and then boring and rifling. The facility of re-lining will be enhanced and the cost of the operation will be greatly reduced in the future by building all new guns with conical liners, susceptible of easy removal. The time of re-lining a gun will thus be reduced from seventy-five to twenty-five days.

Gun Mountings.

For a number of years past rumors have been periodically current that this or that foreign country was about to incorporate a three-gun turret in some new battleship. Such advantages as such a system have heretofore presented were mainly in the direction of economy of armor weights, it being readily demonstrable that six guns can be protected with less weight of armor if mounted in two turrets than if mounted in three. There have been, however, countervailing disadvantages in the increased complexity of ammunition supply, turret machinery, concentration of



Krupp plate of 1905, after attack by three armor-piercing shells. No perforation, but excessive flaking of hardened face.



Krupp plate of 1911, after attack by four armor-piercing shells. No perforation and practically no flaking of surface.

SIX YEARS' IMPROVEMENT IN ARMOR PLATE

weight, and other features of the system which have rendered its adoption inexpedient. The time seems now to have arrived when the necessities of ship design and tactical considerations have forced the triple mount and it is interesting to note that Russia, Austria, Italy, and the United States have all incorporated them their latest battleship designs. It is now decided that United States battleships Nos. 36 and 37 will each carry the triple turrets as a part of their main armament. These turrets will embody certain new ideas in gun mountings which have not yet been embodied in any foreign design

For secondary gun mountings compactness and lightness are essential, but to attain them without sacrificing the rigidity which is necessary for accurate firing requires ingenuity. The mounting for the 6-inch, 51-caliber gun, shown on page 520, is the latest type of this kind of mount which has taken concrete form.

Ammunition.

A nitro-cellulose smokeless powder continues to be the standard propellant for use in our naval guns It is extremely satisfactory in stability, ballistic characteristics, and keeping qualities Powder of the same characteristics and composition is used by the army and it may be safely claimed that there is no better smokeless powder in the world. This powder consists essentially of cotton dissolved in nitric acid, then dried, colloided, and pressed into the desired form of grain.

The colloided material is placed in a press, from which it emerges in long strips and rods. These are then cut up into short lengths of the particular size for the powder grain desired The grains are of different sizes for guns of different calibers, being larger, of course, for the larger calibers. Certain varieties of black and brown powder are still in use for loading shell or for saluting purposes The prismatic brown powder was the immediate predecessor of smokeless powder.

The navy powder is manufactured in lots of from 25,000 pounds to 100,000 pounds, depending on the caliber of gun for which it is intended. Methods of manufacture have been so perfected that these powders, when not unfavorably affected by climatic and other unfavorable conditions, retain their qualities and are serviceable for from twelve to fifteen years In case deterioration occurs due to such conditions, ample warning is given by the physical appearance of the powder, so that no spontaneous explosion or combustion is ever to be apprehended; it is, in fact, extremely doubtful whether spontaneous combustion is possible, unless the powder should be subjected to abnormally high temperatures.

Powder which has changed in character to such an extent as to reduce its ballistic value is now re-worked and made over into new powder of the best quality at a small cost. The re-working consists of grinding the grains in water, drying the resulting paste, and then pressing it into rods or ribbons as required; the methods pursued are much the same as those used in original manufacture.

Smokeless powder possesses many points of superiority over black or brown powder) one of the best known is the fact that its combustion produces but little smoke; such as is produced is largely gaseous in nature, containing very little solid matter, and it is, therefore, quickly dissipated This fact gives to the use of smokeless powder a great tactical advantage for military and naval purposes A second point of superiority lies in the fact that the combustion of smokeless powder is practically complete, there being an exceedingly small percentage of solid residue remaining; the whole mass of the powder is, therefore, converted into gas, the expansion of which imparts velocity to the projectile

The particular form of grain in use for all guns of large caliber is what is known as the "multiperforated" form, in which the cylindrical grain is pierced by a number of longitudinal holes When such a grain is ignited the burning progresses both from and toward the center with the result that the burning surface is practically constant until the grain is entirely consumed In consequence of this fact the volumes of gas produced in any two units of time while the projectile is in the gun and traveling toward the muzzle are nearly equal, and the maximum pressure on the walls of the gun is not so much greater than the mean pressure as to require that the breech of the gun be made enormously heavy as compared with the chase and muzzle, as was the case with guns designed for use with quick-burning black powder

The quality of projectiles is being slowly but surely improved. The possible range has been increased by changing the form of the head from the blunt type in general use in recent years, to a long, sharp ogival The above illustration shows the present type of shell for guns of 5-inch to 14-inch caliber The point of the shell, in all except the 5-inch, is a separate piece from the remainder of the shell and is made of soft steel, the body of the shell is of very hard and tough forged steel, containing alloys of nickel, chrome, vanadium and other metals. It is in the quality and composition of the steel used, and in the methods of treatment, which give the shell hardness without brittleness, that the principal improvements have been made in recent years. These points are, in the main, manufacturers' secrets, not disclosed even to government officials.

The function of the soft steel cap is to support and guide the hard point of the shell and thus enable it to "bite" and penetrate the armor on impact. The addition of this very simple device to steel shell increases their penetrative efficiency fully 20 per cent Such caps have been in use for a number of years, it is only their form that has been recently changed

High-explosive bursting charges are a necessity in modern armor-piercing shell The walls of these shell must be very thick in order that the shell may withstand the terrific shock of impact on armor and that it may penetrate, the interior cavity is thus too small to contain a sufficient amount of "gun powder," as commonly understood, to disrupt the shell The use of a more powerful explosive is therefore necessary.

As an alternative to the adopted method of attack on armor i. e., by means of a projectile designed to penetrate and explode inside, the method of attacking with shell exploding on contact has been suggested and has been strongly urged by some persons of undoubted knowledge and attainments The latter method depends for its efficiency on smashing or displacing the armor by the force of the impact and the intensity of the resulting explosion Experiments have been made along these lines from time to time, but, while the damage done to an armor plate by the detonation of a quantity of high explosive in contact with it is admittedly great, it has not yet been demonstrated that a charge of any explosive which can be safely fired from a gun can effect as great damage in this way as can be effected by detonating inside a vessel an equivalent charge of explosive which can be so fired The "Puritan" experiments only confirmed the official opinions previously held on this point



Relative size of naval shells from 5-inch to 14-inch

The powder charge, weighing 370 pounds, discharges the 1,400-pound shell with a muzzle velocity of 2,600 feet per second, and a muzzle energy of 65,687 foot-tons. At 10,000 yards the shell will penetrate 15 9 inches of Krupp armor.

SHELL, POWDER, AND BREECH MECHANISM OF THE NEW 14-INCH NAVAL GUN

Torpedoes.

The torpedo continues to be held in great favor as a weapon of under-water attack, and it must be admitted that no navy has at present an adequate system of defense against such attack if efficiently delivered Torpedo nets as carried by the vessels of some foreign navies are ineffective since torpedoes have been designed which can cut, penetrate or displace the nets The searchlight is ineffective, since a torpedo may be successfully launched at a range beyond its reach Gunfire is ineffective against an invisible target and the torpedo boat can launch its weapon while still invisible to the gun Pickets and scouts are not thoroughly effective, since they may, themselves, be attacked and disabled, or they may be eluded The practical torpedo of the present day may be effectively used at a range of 8,000 yards, a range of 10,000 yards at 27 knots speed is confidently expected in the near future The United States Navy now has in course of building two types of torpedo which will, beyond a doubt, fill these conditions and may exceed them The reliability of the torpedo in the hands of the general service is, unfortunately, still questionable and many failures and wild shots are to be expected There is, however, nothing mechanically impossible in the conditions of the problem of making torpedoes reliable, and recent advances in this direction justify the hope that in the near future a thoroughly accurate long-range weapon will be produced

The "Vesuvius," built for discharging so-called aerial torpedoes, is now employed at the Newport Torpedo Station as a torpedo testing vessel

(Continued on page 534.)

Rank of the United States Among the Naval Powers

Our Present Standing Threatened by the Lack of Colliers and Other Auxiliaries

By Capt. T. M. Potts, U. S. N., Chief of the Office of Intelligence

THIS question has been very often asked of late as to how the United States Navy ranks among the naval powers. Ordinarily, this question is answered by giving a tabulated statement of the effective war tonnage of the various nations and establishing their rank with one another in accordance with the amount of their displacement. This answer is accepted by most laymen as being conclusive, but to naval officers and students of naval affairs it is far from being so. To naval officers two questions naturally arise: What constitutes Naval Strength? How is Naval Strength measured? Therefore, in attempting to fix the rank of the United States Navy with reference to that of other powers, consideration must be given—not only to battleships, but to all the various types of vessels which go to make up an efficient well balanced fleet; to the Merchant Marine upon which a nation must draw in time of war for certain types of ships, and lastly to personnel, active and in reserve, all of which go to make up a well organized navy and measure its strength.

Fleets are created and maintained for offensive operations, and while often spoken of as the mobile defense of a country, the defense lies in the fleet's ability to assume operations against an enemy's fleet, or against the coast or territory of an enemy.

The table below shows the composition of the fleets of England, France, Germany, the United States and Japan, and includes vessels which will probably be in commission or ready for commission on January 1st, 1912.

The launching of the first all big-gun battleship the Dreadnought, in England in 1906, completely revolutionized modern battleship construction—so far as offensive power is concerned. The question of an all big-gun ship had often been discussed and elaborated upon by other nations, but the English were the first to put these ideas to a practical use. All-big-gun battleships constitute a distinct type, and all ships launched since that year have been spoken of as dreadnoughts. The building of this ship placed the navies of all powers upon an entirely different status from that which they had previously occupied, for the Dreadnought completely eclipsed in offensive power all ships previously built. Earlier ships, however, so long as they are employed in the active service of navies, cannot be considered as absolutely obsolete at the present writing, but in a few years, as the number of dreadnoughts increases, they will undoubtedly be relegated to the second line.

Another type of warship, commonly known as the battleship-cruiser, has developed within the last five years and bids fair to be an important factor in all future naval engagements. The first of these ships was launched by England and called the "Invincible," so that the term Invincible is now considered to represent a distinct type of a battleship.

In analyzing the composition of the various fleets of the world, fighting or capital ships, as they are now termed, may be divided into three distinct classes, pre-dreadnoughts, or ships that were built or laid down prior to 1906, dreadnoughts, or all-big-gun-ships, and Invincibles. Battleship-cruisers, with a very high speed, carry a smaller number of heavy guns, of the same caliber as those of modern battleships, and their protection has been somewhat reduced. They must, however, be considered as capital ships.

The table shows that the total warship tonnage of Great Britain is considerably more than double that of any other nation, and, therefore, entitles Great Britain to the position of first in the rank of naval powers. When we come to consider the naval strength of other powers, we find a difference of only about 15,000 tons in the warship tonnage of Germany and the United States, a difference which a layman would probably consider a negligible quantity, or in other words, that these two countries were practically on the same footing. The character of the vessels which make up the fleets of Germany and the United States will, however, be carefully considered by those who wish to determine the exact standing of the two fleets.

Total Weight of Metal of Primary Broadside of Capital Ships, January 1st, 1912.

		Weight of Metal of Primary Broadside.		
	No.	German).	No.	United States.
		Lbs.		Lbs.
Battleships (Dreadnought type)	7	44,340	6	50,220
Battleships (pre-Dreadnought)	21	62,540	25	132,435
Battleship Cruisers	2	11,900		
Armored Cruisers	9	15,130	12	25,500
		133,910		208,155



As pointed out in the accompanying article, the weak point in the U. S. Navy is its limited supply of auxiliary ships, the most important of which is the collier.

NAVAL COLLIER COALING THE BATTLESHIP "SOUTH CAROLINA"

The German battleship fleet will, on January 1st, 1912, consist of seven dreadnoughts, twenty-one pre-dreadnoughts and two battleship-cruisers, a total of thirty capital ships, as opposed to thirty-one capital ships in the United States Navy, composed of six dreadnoughts and 25 pre-dreadnoughts, so that numerically, the fleets will be practically equal. When we come, however, to consider the actual fighting value of the units which make up the two fleets we find that, ship for ship, the United States vessels are decidedly superior to those built at a corresponding period in Germany, especially in offensive power.

The ten vessels of the "Kaiser" and "Wittelsbach" types carry a main battery of only four 9.4-inch guns, while the ten following vessels of the "Braunschweig" and "Deutschland" types carry only four 11-inch guns in the main battery, as opposed to these, all the battleships of the United States carry main batteries of four 12-inch, or four 13-inch guns, supplemented in all except the six vessels of the "Maine" and "Illinois" types of intermediate batteries of from four to eight 8-inch guns.

France will have only twenty-one pre-dreadnoughts ready for service on the first of January, 1912, while Japan will have but thirteen, although the latter nation will on that date have two of the battleship-cruiser type.

Of the thirteen battleships which comprise the fleet of Japan, the "Fuji" is practically obsolete; five are reconstructed and repaired vessels captured in the late war and two are coast defense vessel type. The batteries of the two vessels of the "Satsuma" class—4-12 inch and 12-10 inch guns—are so powerful, however, that these vessels should properly be considered dreadnoughts, and the two vessels of the "Kawachi" type carry batteries considerably more powerful than other pre-dreadnoughts of the same period of building.

The comparison, therefore, between these four countries as to their battle fleets, is decidedly in favor of the United States, and it may be contended that so far as the strength of the battleship fleet is concerned that the United States is decidedly superior to that of either France, Germany, Japan, or any other nation.

Considering the geographical and political conditions in the United States, students are pretty generally of the opinion that, in the event of future hostilities between this country and any other nation, the United States will have to carry on an offensive warfare; in other words, will be compelled to take the initiative and to carry on warfare far removed

Probable Warship Tonnage of the Principal Naval Powers January 1st, 1912.

	Great Britain.		Germany.		United States.		France.		Japan.	
	No.	Tons.	No.	Tons.	No.	Tons.	No.	Tons.	No.	Tons.
Vessels Completed.										
Battleships (Dreadnought type)	11	213,850	7	138,000	6	115,650				
Battleships, first-class	46	672,300	21	252,712	25	334,146	21	300,676	13	191,698
Coast defense vessels			5	20,273	4	12,900	2	15,400	2	9,086
Armored cruisers (new type)	5	96,850	2	41,000					2	29,200
Armored cruisers	14	196,800	9	94,215	12	157,445	22	211,070	11	108,900
Cruisers above 6,000 tons	14	116,500			5	43,800	3	24,022	2	13,130
Cruisers 6,000 to 3,000 tons	12	200,180	24	98,180	14	49,541	5	21,250	8	30,303
Cruisers 3,000 to 1,000 tons	23	19,510	15	34,528	10	12,260	2	4,706	5	9,158
Torpedo boat destroyers	205	142,210	107	57,012	36	21,306	72	36,782	59	22,957
Torpedo boats	59	22,710	22	3,749	28	4,802	325	21,324	59	5,580
Submarines	71	23,282	14	4,080	26	7,200	66	17,680	10	1,833
Total completed		1,931,502		744,719		759,050		642,810		421,834
Vessels Building and Authorized.										
Battleships (Dreadnought type)	11	263,500	9	216,500	6	162,000	4	92,400	2	41,600
Battleships										
Coast Defense vessels										
Armored cruisers (new type)	5	116,650	3	73,000					2	55,000
Armored cruisers										
Cruisers above 6,000 tons										
Cruisers 6,000 to 3,000 tons	10	52,360	6	33,750					3	15,000
Cruisers 3,000 to 1,000 tons					1	1,500				
Torpedo boat destroyers	24	18,100	12	9,600	14	12,450	19	13,700	8	8,550
Torpedo boats							2	360		
Submarines	14	11,500	12	6,000	13	7,150	18	10,500	3	1,260
Total building and authorized		462,110		337,850		183,100		116,960		125,410
Total completed, building, and authorized		2,396,912		1,082,569		942,150		759,770		547,244

from our coasts or naval bases. This leads up to a consideration of the number and character of the vessels which make up an efficient, well balanced fleet for offensive operations, such as torpedo destroyers, scouts, repair ships, fuel ships, ammunition ships, hospital ships, transports, supply ships and mine-laying vessels—all of which are essential adjuncts of a fleet.

Torpedo Destroyers.

It is considered by students of naval operations that at least four torpedo destroyers are necessary for the defense of each battleship

The rapid development of the automobile torpedo and its increased range render it practically impossible to defend a fleet by means of illumination or the use of searchlights, as the torpedo has now reached a range beyond which, even under the most favorable conditions, the searchlight is of doubtful

Scouts.

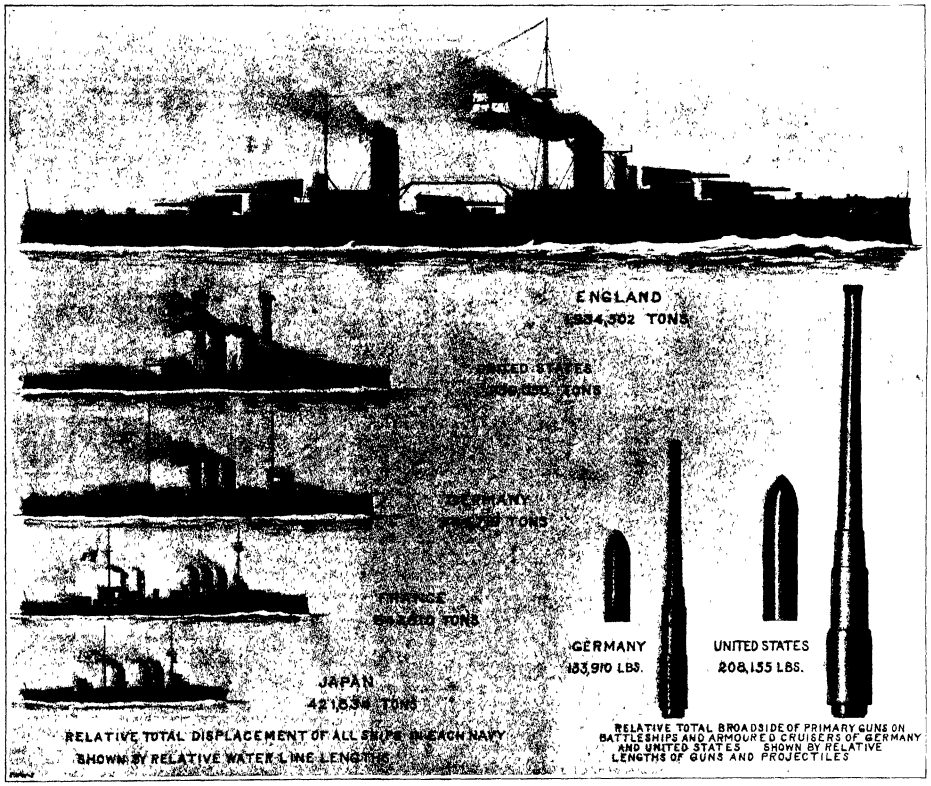
The scout is the eye of the fleet, and no matter whether our fleet is operating on the defensive along our own coasts or on the offensive on an enemy's coast, information as to the movement of the enemy is a most important factor in conducting naval operations The scout is in no sense of the word a fighting vessel, and its principal characteristics should be speed, ability to steam at high speed in all weathers and ability to keep the sea for long periods without replenishing its fuel supply

While the introduction of wireless outfits on board modern ships is of the greatest possible value, interference with the successful transmission of a message from a scout to the main body of the fleet is not difficult of accomplishment, and in order to convey important information to the Commander-in-Chief

adequate our merchant ships are for scouting purposes As against the three vessels of this special type, England possesses twenty-three, with nine building, Germany ten, with six building, and Japan four, with three building, therefore, so far as this type of vessel is concerned, the United States Navy is decidedly inferior to those of England, Germany and Japan On the other hand, these three countries possesses in their Merchant Marine a large number of vessels, which in a very short time can be converted into efficient scouts

Fuel and Ammunition.

One of the most important things to be considered in the operations of an offensive fleet is the problem of supplying fuel and ammunition Battleships whose fuel or ammunition supply has been reduced or exhausted cannot be considered very formidable Ar



The greater gun power of the U. S. Navy as compared with that of Germany is due to our pre-dreadnought ships carrying heavier guns in the main batteries Future sea-fights will be fought with dreadnoughts. At the present rate of construction, Germany, in 1917, will possess twice as many dreadnoughts as the United States.

GRAPHIC COMPARISON OF THE RELATIVE STRENGTH OF THE WORLD'S NAVIES

value We must, therefore, depend, for the protection of our battleship fleet, if operating upon an enemy's coast or in proximity to its battleship fleet, upon torpedo destroyers, scouts and other outlying vessels, thrown out as a shield for the protection of the battleships.

An examination of the table shows that on January first, 1912, England will have two hundred and five torpedo destroyers, Germany one hundred and seven, France seventy-two, Japan fifty-nine, while the United States will possess but thirty-six This shows that the United States is woefully deficient in torpedo destroyers, as the estimated number for the protection of a fleet composed of sixteen vessels is sixty-four, and therefore, so far as this element of strength is concerned, the United States ranks below Great Britain, Germany, France and Japan.

of a fleet, it may be necessary for the vessel obtaining such information to communicate with the fleet by visual signals While the scout also forms part of the outposts of a fleet for its defense against surprise and against torpedo attack, its principal function is discovering the whereabouts of the enemy's fleet, keeping in touch with and successfully transmitting information as to its movements—to its own fleet.

The United States Navy possesses but three vessels of this important type, and furthermore, its Merchant Marine does not furnish a single vessel which is in all respects adapted for scouting purposes Few, if any, of our merchant vessels are capable of reaching a speed of more than twenty-one knots, and when it is considered that the modern scout has a speed of at least twenty-six knots, it is clearly seen how in-

rangements must be made for the furnishing of fuel to our battleships at stated intervals either through colliers built for this purpose by the Government or else through vessels bought or chartered for the purpose The United States Navy possesses to-day twenty colliers fit for service, but a large percentage of these vessels has such a small cargo-carrying capacity as to be of little value to the fleet England, Germany and Japan possess few, if any, regular naval colliers, but each of these countries possess a very large Merchant Marine, from which colliers supply vessels and other auxiliaries will be drawn in the event of hostilities We possess no such marine and to-day there are but very few vessels flying the American flag which are at all suitable for naval purposes in any character Unless, therefore, something is done to

(Continued on page 452)

On Board a Battleship

Intimate View of the Life of a Community of One Thousand Souls

By Captain Albert Gleaves, Commanding U. S. Battleship "North Dakota"

LIFE on board ship is but little understood by the general and the ways of the service, if not past finding out, are a closed book to the majority of our fellow citizens. A more intimate contact between the people of the service and commercial people would benefit both with the result that there would be less apprehension for the pocket book when battleships are proposed and less talk of the Angel of Peace hanging his head at the sight of a Building Program. On the contrary, if the Navy and the people knew each other better the "sober citizen" would realize from personal knowledge that he is paying only a trifling insurance on his property for a very real and substantial protection, and the Angel of Peace, instead of protesting would preen his wings for higher flights and chant the ringing notes of an *Io triumphe* as he soared.

Although the Atlantic fleet of twenty to twenty five capital ships and its accompanying auxiliaries, such as colliers, supply and store ships, and repair ships, represent an enormous outlay of public funds the sum is insignificant when compared with the almost fabulous wealth that it protects and the security that it affords. Some one who has a genius for statistics estimates the money value of every enlisted man as $5,000, and places the value of the fleet at 300 millions. If a committee of citizens from all parts of the country could visit the fleet on the Southern Drill Grounds when the ships are cleared for action and just as prepared to engage an enemy as they are to shoot up an irresponsive and insensate target, it would require no argument to prove the need of a navy, nor many arguments to demonstrate the absolute necessity of definite expansion in order to maintain a *vigorous* one. That task, however, is for others. The object of this article is to give some idea to the layman of the *ne intime* on board a battleship in the fleet, how the men live and what they do.

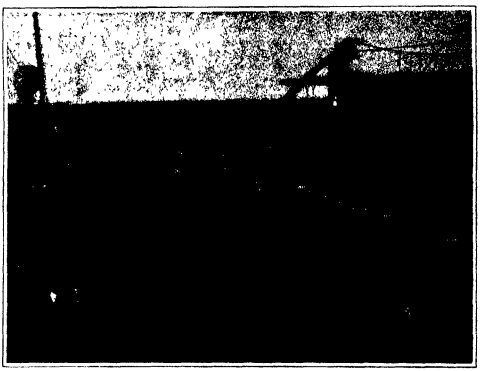
Due to perspective the first view of a battleship may be disappointing. She will probably not appear as big as she has been described, but, once on board, this delusion vanishes. She is a master piece of man's cunning and ingenuity that excites enthusiasm, but she must be studied much and long before she is fully comprehended. Viewed from the taffrail looking forward and upward there is nothing more impressive of the majesty and power of a ship. The eye catches in one glance the armored turrets, the searchlight towers, the broad-bellied funnels, the pendulous cranes and towering above all those prodigies of naval construction the lattice masts—the very latest thing in battleships—called by our sailors "haystacks," and by the English "scrap-baskets."

Each turret with its pair of 12-inch guns weighs about seven hundred tons, but in spite of the inertia of the mass it is so nicely balanced that the guns can be laid to a hairs breadth on the target, and with no more physical effort than is required to turn a wheel of more or less. The guns fire a shell of 870 pounds with a powder charge of 310, and they can be loaded, aimed and fired every thirty seconds, and with such marvelous accuracy and precision, that at a range of five miles they can make twenty per cent of hits on the target, which at that distance appears in the telescope of the gun no bigger than an open umbrella.

A battleship comprises a community of approximately one thousand souls, in which a centralized and autocratic government prevails. The division of labor, exercises and drills, the rules that govern the hours of eating, sleeping and recreation are the last words in routine and organization. Every man has his place and number, and there is not an article on board, from a torpedo to a water breaker that has not its allotted space. Order and system are paramount and the very atmosphere breathes of discipline. At no time is this so apparent as in an emergency, at every signal of danger, whether it be of fire, collision or man overboard, every man instantly jumps to his station, with a perfect knowledge of what is expected of him, but until he gets there, he doesn't know whether it is the real thing or a drill.

The head of this community of sea-people is, of course, the captain. In battle his station is in the conning tower, and under his hand are all the latent Titanic forces of powder, gun-cotton and steam, which may be released only at his bidding. In matters of administration he is judge and jury, and daily at the mast the delinquents are brought before him; he listens to the evidence, and there is no law's delay in his judgments. He messes alone, and his life for the most part is a solitary one. A wise captain will not burden himself unnecessarily; if he would be happy, he must apply to his duties what the Romans used to say of the Praetor, *de minimis non curat*, leaving to others "the mere rude explicit details."

The wardroom mess is presided over by the commander or executive officer, and is composed of the staff officers and the lieutenants. And merry times they have when the rigid discipline of the day's work gives place to post-prandial relaxation of the evening. Then there are the junior officers' mess composed of midshipmen, and also the mess composed of warrant officers, those men of the rank and file who by faithful service have become gunners, boatswains and machinists. Cheeks and Chips as described by Marryat are as dead as Henry IV. The old stories of the wind jammers have passed into oblivion, and the service to-day is unconsciously working out new traditions that will be handed down to the coming generation of sea folk.



Of this most effective corps, each battleship carries two officers and sixty to seventy men.

THE MARINES

Forward of the mast there is a big household, which requires $75,000 per month to care for clothes and feed in their ten-million-dollar home. Nearly all trades are represented in this little kingdom of the sea. Tailors, shoemakers, photographers, jewelers, barbers, and musicians, for the most part a man is allowed to ply his trade so long as there is no interference with his military duties. Regular prices are established by the captain, and as there is no competition, each has a large *clientele*. The galleys have the best possible system of cooking, supplemented with electric potato peelers, electric meat choppers and electric dish washers. The bakery provides bread at all times instead of hard-tack, which was formerly supplied, and furnishes seven hundred loaves daily; there is a laundry, which has a fine equipment of machines run by electricity, and is handled by sailors who are excused from all other work except battle and fire stations, a cold storage with a capacity for provisions for one month for the entire ship's company, and a hospital or sick-bay, well lighted and well ventilated, which is located in a comfortable part of the ship. The hospital contains a sick ward proper with bunks for a score of patients, the isolation ward and the operating room. The last is fitted with every convenience known to modern practice, including an adjustable operating table and a sterilizing plant. Every battleship has a branch post-office in charge of sailors appointed by the captain, which is under the same postal regulations that govern the shore stations. A complete telephone system connects all parts of the ship, and is supplemented by voice pipe communication, which is used principally in action. There is also a wireless installation, and officers as well as the operators are encouraged to become proficient in its use.

Those who are concerned especially for the moral welfare of the men will be interested in the "brig" as sailors call the prison, and they will perhaps be surprised at the spacious, not to say comfortable *points d'arret* of those who violate the Articles for the Better Government of the Navy. Down below the gun deck are the berth deck spaces, and still farther below are innumerable storerooms, the magazines and torpedo room, ammunition passages and dynamo rooms.

The pay of the men varies from twenty to one hundred and fifteen dollars per month, depending upon the rate, length of service and conduct. Those who wish to save their money may deposit it in the bank with the paymaster, and the government pays four per cent interest. As the term of enlistment is for four years, it is not difficult for a man to save as much as fifty or sixty per cent of his pay during his cruise.

On Sundays after inspection, the bugler sounds the church call, and the church pennant, a blue cross on a white triangle, is hoisted *above* the national colors. Attendance at church is of course not compulsory, but in the words of the Articles of War, "it is earnestly recommended to all officers, seamen and others in the naval service diligently to attend at every performance of the worship of Almighty God." The altar is rigged below decks, and apprentices selected from the Catholic lads act as acolytes, the priest in his vestments conducts the services with all the rites of bell, book and candle, as if on shore. A large percentage of the crew are usually Roman Catholics, and so the temporary church is always crowded.

Of course the whole idea of a ship and its reason for being is to fight, and until a captain can feel that his ship is ready at all times for battle, his task remains incomplete. The nearest approach to action at present is the semi-annual target practice, and the rivalries of the Derby and the Ascot are as nothing compared with the competition between ships for the coveted gunnery pennant and the bronze trophy, that Ark of the Covenant which is the final *cachet* of efficiency and achievement. During the period of preparation immediately preceding the practice, when "days are full of labor and nights devoid of ease," and everybody is under a strain like that of the first public speech, one hears nothing in the mess rooms and about the decks but discussion and arguments relating to "hits per gun per minute," this or that system of fire-control, and the latest suggestions for "plotting and tracking." The ships lose their smart appearance, for there is no time for the paint brush and the holy-stone; men and officers are rarely out of dungarees, they live in the turrets, working day and night to perfect the adjustment of every detail of the mechanism for loading, training and firing. When the day arrives for which the months before have been a training, the ship is cleared for action, and stripped of all superfluous articles until she looks as sleek as a race horse clean groomed from the paddock. The scheme, generally speaking, is this: The ship steams to the firing line far away from the target, then rounds to, and makes the "approach" at full speed. When she comes within range, fire is opened at the target, which looks like a blur in the haze. *It* a division of four ships are engaging a string of targets towed in tandem, it is a sight never to be forgotten. Broadside follows broadside with astonishing rapidity; the thunder of the guns is deafening and would be absolutely destructive to the ear drums, were it not for ear protectors. The people in the turrets and in the conning tower experience no inconvenience from

its cause, but out on the deck in the open, the shock is tremendous, so much so that a broadside of ten guns heels a 20,000-ton ship four degrees. When the firing begins, hot blasts from the guns flick the air, in flame-slitted reddish brown smoke spurts in thick clouds from their "rude throats," but dissipates almost instantly, and the air is filled with the pungent odors of burnt gases. The spotters aloft watch anxiously for the geyser-like splashes, that show where the shot struck, and the sight-bar ranges are quickly changed until the gun-pointers are "on."

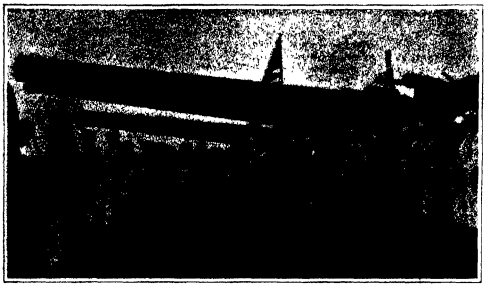
There are other drills and many of them; abandon ship, fire, and collision, signals and boats, and in addition there is the never-ending work of the care and upkeep of the ship, which must go on constantly.

But besides being sailormen by profession, the bluejackets are given something more than an elementary instruction in soldiering; they drill as companies, regiments and brigades; they make practice marches, and when occasion offers they go into camp as at Guantanamo.

But it is not all work on board ships; there is some beer and skittles. The routine keeps every one busy pretty much all the time, still there are intervals between drills, and on certain afternoons, when there are no drills at all and the men may smoke and mend their clothes, or get down to their ditty boxes, and spend an hour or so with old letters and photographs. Smokers are a feature of life on board, and there is nothing like the quarter deck of a battleship for the *mise en scene* of a wrestling bout, a boxing match, a song and dance, juggling, slack wire performance, or any other stunts for which there is ample talent in a crew of one thousand men. Then the tops of the turrets are crowded with the bleachers, and officers and crew gather together around the improvised ring. Usually the athletic officer or the chaplain is the master of the revels. It is astonishing how much genuine talent is found in a ship's company, and the artists are always ready to contribute to the entertainment of their shipmates.

In the evening after supper when the band plays, the men dance and sing or gather around the turrets and "gam" until nine o'clock, when it is pipe down and all hands must turn in. Sometimes there are moving picture shows on the quarter deck, the films are all carefully selected, and as each ship passes here to the next, there is a great variety in the fleet. Those of dramatic and romantic character are the most popular, and always draw rounds of applause. Recently on one ship, when thirty miles at sea, butterflies blown off by the land breeze had fluttered around the ridge-ropes and life-lines all day; but the finishing home touch was given at night, during one of the moving picture shows, by the chirping of a cricket hidden somewhere in the cork fenders.

Very little of the old navy is left in the new, either in equipment, manners or customs. There is even a new terminology. The bow-legged type of sailor with coppery nose, groggy eyes and a collar of whiskers around his face, survives only in the penny-dreadfuls and comic operas. He has given place to bright-eyed lads, lean in the flank, well groomed, quick and ready to meet any emergency. It is worth noting that the average age of the ship's company is less than 25 years. The man-of-war's man of to-day is a self-respecting, intelligent citizen (only about four per cent are aliens) who reflects credit on the flag wherever he may go. In the cruise of the Atlantic fleet to Europe last winter, 12,000 men visited London and Paris, and there were only a few instances of serious misconduct, and although leave was granted to visit Norway, Sweden, Germany and Ireland, there was no instance where they did not return to their ships, and for the most part on time. The appearance of our men drew forth from an English writer a shrieking article commenting on their lankness, lack of physique, and, tell it not in Gath, in some special cases their kid gloves and eye glasses. A French artist in Paris was not more complimentary in his cartoons. However, it is good to see ourselves as others see us, and as we are not responsible for foreign spectacles we may afford to be amused. There is another point. The Honorable Herbert Satterlee recently referred to the United States Navy as the Great American University. The comparison is apt and just. It is a university whose students number 48,000 youths and men from all parts of the country. This ocean university costs the Government 140 millions annually, but in it is taught that which above all things is the corner stone of every great nation, respect and obedience to constituted authority. The hundreds of sailors who yearly leave the navy with honorable discharges, and go out in every day life become, it may be unconsciously, missionaries for the service. They return to their people with the story of those who live between sea and cloud, who pursue their occasions on the sea in craft as different from the ships of yesterday as the ark differed from the Navy of Tarshish. In time their knowledge of the service will spread, and gradually the people will come to have as much pride in their navy as the British people have in theirs, and when that time comes there will be no fear or apprehension as to our future security on the seas. For those who believe that the navy as it is to-day, is all that the nation requires, it will be well to recall what Emerson said of our civilization. "We think it near its meridian, but we are yet only at the cock-crowing and the morning star."



The complement of our latest battleships is one thousand officers and men of whom the greater part are seamen.

THE SEAMEN





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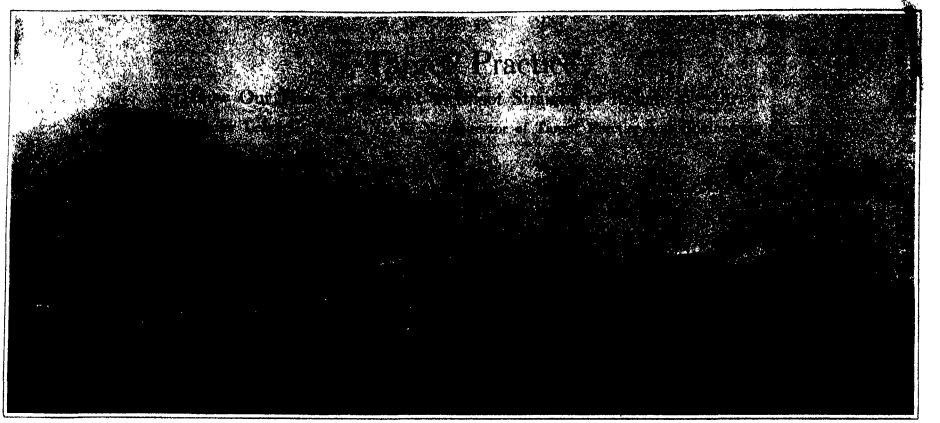
This remarkable photograph, taken from the bow of the "Connecticut," shows only one-third of the total complement of 980 officers and men. Admiral Osterhaus, commander-in-chief of the Atlantic fleet, is the central figure in the second line.

ON THE FO'CAS'LE DECK OF THE U. S. FLAGSHIP "CONNECTICUT"

The Cooling of Ammunition Rooms

THE unparalelled catastrophe by which the French battleship "Liberte" was sunk has brought the question of the temperature of the ammunition rooms once more into prominence. The report of Vice Admiral Bellue upon the temperature of the ammunition rooms of the battleship "Jules Michelet" during the period from April to October has now been published. The Minister of the Navy considers that the temperature of 30 deg Cent at which the powder remained in some of the rooms is altogether too high. The temperature is now to be kept below 25 deg. Cent. Upon some of the battleships such as the "Danton" and "Voltaire," the Leblanc refrigerating system, which was installed, has been giving very good results.

In view of the tragic results which may follow from the deterioration of modern smokeless powders, it is gratifying to remember that our own naval powder has shown a marked stability, and that our own methods of cooling and ventilating the ammunition rooms are giving satisfaction.



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HEAVY WEATHER IN THE NORTH ATLANTIC

A SAILOR'S preparation for battle begins the moment he comes aboard ship. Within half an hour of his arrival, he has been given a station at a gun with some of the oldest sailors to instruct him in his duties. The new recruit is first tried at aiming drill with a rifle, to see if there are any personal errors that are likely to disqualify him from the start. If he passes this preliminary step he is taken immediately to the mechanical instruments, "dotter" and "Morris tube," and is directed to aim at a stationary target. An officer supervises this exercise, and after two or three days' work at a stationary target, the recruit is exercised at a moving target so as to develop his skill in controlling the electrical elevating and training gear in any kind of a seaway that may be encountered in "action." He actually operates the elevating and training gear of the gun he will handle in battle so that his education is practical from the start.

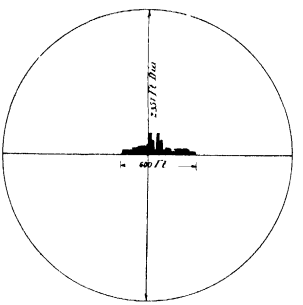
It is easy enough to develop gun pointers to fire from a stationary platform, or to fire in smooth water from a ship under way. As soon as the elements of roll and pitch are brought in, however, an entirely different kind of training is necessary, and it is found that a man who is expert in smooth water may be of no use whatever when firing from a platform, whose motion is as irregular as that of a ship in a moderate sea.

In order that no time may be lost by training gun pointers under smooth water conditions, the motion of the mechanical "dotter" is made to simulate, as nearly as possible the motion of the ship in a seaway, so that the man may not be deprived of this training, should the ship be alongside the dock or in a navy yard for urgent repairs.

The "dotter" is an electrically controlled instrument, so constructed that the target, a miniature ship will have the same motion with reference to the pointer's eye as an enemy's ship would have if viewed from one of our vessels, steaming at high speed in a heavy sea. When the cross wires of the pointer's telescope are exactly on the center of the target the gun-firing key should be pressed causing an electrically operated pencil to make a dot on the target sheet. The target being in motion both vertically and horizontally the pointer's skill is gaged by the rapidity and accuracy with which he places his "dots" when aiming at the center of the target. The "Morris tube" is a somewhat similar instrument with the exception that a small rifle attached to the heavy gun is fired electrically and sends its bullet through the target sheet.

The Navy Department has issued a general order that gun-pointers shall be trained throughout the year several times each week, so that no matter on what duty engaged or in what country the ship may be, guns' crews will be in such efficient condition that they can engage in action at a moment's notice. This order has had a very far reaching effect, for it keeps the whole personnel and material of the ships up to the highest standard of efficiency at all times.

When the gun-pointers have been trained so that they can follow a rapidly-moving target and make hits with great skill, they are taught to fire on signal,



Appearance of battleship at 10,000 yards, as seen through gun-sight telescope.

so that whole broadsides may be fired at the same instant. This requires unusual concentration on their part and a most intimate knowledge of the electrical gear by which the guns are controlled. The pointers are required to fire within a second after the firing signal is given, and when it is remembered that they operate the controlling levers of the enormous 60-ton guns and of the turrets of 500 tons weight each, making them follow the peculiar and mystifying roll and pitch of the ship it can well be seen that constant training and wonderful skill are necessary.

During all the above mentioned training the other members of the guns' crews, the sight-setters who mark the range given by the fire control officers, the men who open the breech-plugs, the men who put in the powder, and the men who hoist and ram home the projectiles are all being daily and competitively trained.

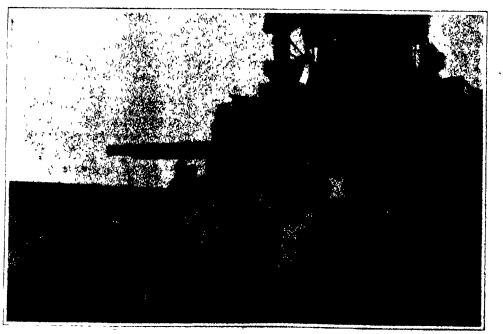
It is this feature of competition that has had most to do with the remarkable development of gunnery in the Navy, for every officer and man is in competition with every other, and at the completion of the target practice or at the end of the year's gunnery work, they receive their rewards in trophies, letters of commendation, and gunnery "E's," which last may be worn only by men of winning gun or turret crews as a special mark of efficiency.

No detail of the training is too small to be given the undivided attention of the officer in charge. The apparently simple motion of setting the sights for each new range has to be watched from day to day, by giving numerous sets of ranges to several men in competition, and noting the rapidity and accuracy with which each accomplishes the work assigned him.

The men who open the heavy breech-plugs, one-half ton in weight, do so wholly by hand-power, as it is found to be as rapid and more reliable than any mechanical means. Even in this particular work the men are placed in competition, for the officer stands by with his stopwatch and starts two plugmen at the same instant withdrawing their plugs, noting the time when each has completed his work. With skilled plugmen this varies from 2 2/5 seconds to 3 seconds for 12-inch guns, and the slower plugmen are given other work requiring less speed and strength.

Every step of the drill is carefully worked out before any two steps are combined. All the men are tried out to see which ones will make the best powder passers, and as this is very trying work during a protracted engagement, only the strongest and most active men are selected for this duty.

The men who ram home the enormous projectiles, weighing 870 pounds, require a great deal of drill, for a slight error of a fifth of a second in applying the necessary force to seat them may well cause



This crew in No. 3 turret made the highest score on Southern Drill Grounds in the spring battle practice in 1911.

PRIZE WINNING CREW OF U. S. S. "MICHIGAN"

the loss of 3 or 4 seconds in the complete load As it is necessary to deliver the greatest number of hits in the shortest possible time after the enemy is sighted, it will be seen how vital it is that not a fraction of a second should be lost in any of the details of loading or firing. It may well happen in a naval duel between two battleships that one of them will be put out of action within five minutes after the first shot is fired

Although to the casual observer of the daily competitive drills there appears only the keen sportsman's instinct to win, there is also a grim feeling that some day the national honor may depend upon the saving of a few seconds, enabling us to deliver a broadside of highly destructive projectiles into the vital parts of an enemy at a critical moment

The character of the enlisted force of the service has changed remarkably in the last 15 years There is a community of interest between the officers and men The reasons for every order are fully explained, so that the men are thoroughly familiar with the object sought and with the material used. This applies not only to loading and firing the guns but to the whole fire-control and range-finding system, so that when a naval battle is fought, intelligent petty officers may take the place of officers who are killed or disabled The whole service is working together with one end in view, that of efficiency in battle

A recent order of the Navy Department calls for carrying out the drills with guns and fire-control parties during rain, snow and heavy weather generally, so that our men may be prepared for the most adverse weather conditions to be encountered "in action" Crews drilled in smooth water only and in fair weather are worthless when firing in rough weather in the open seas

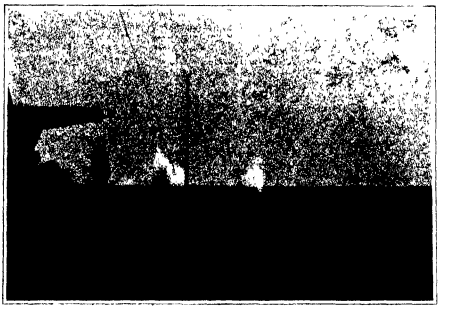
After the training with the mechanical targets on board ship is completed and after the loading crews are well instructed, a certain amount of ammunition is provided to fire the guns under the same conditions as would obtain 'in action," so that the officers may find out definitely whether or not any particular pointer is "gun shy" During this practice a target is used on which the hits are recorded, or photographic records are kept, so that the final efficiency of the gun-pointer is obtained while the guns are actually firing Should a pointer show any evidence of being "gun shy," he is immediately dismissed from the gun crew The training from now on is a co-ordination of all the units, that is of all the gun crews and fire-control parties, so that when the day comes for the final test of the ship at battle practice in heavy weather, the team work will show how faithfully the individual operations have been performed

At battle practice the conditions are made just as severe as those that would obtain in actual "action" The firing vessel has no knowledge of the course, speed, or distance of the target vessel All the information she has is that somewhere on the horizon at a distance of 10 miles or more is a column of smoke which marks the enemy at which she is to shoot She steams toward it at her best speed and opens fire at whatever range she chooses, but the value of hitting at long ranges is vitally impressed on her by the amount which is added to or subtracted from her score for the shots that hit beyond 12,000 yards or under that mark The whole firing is finished in four minutes and she has no other chance to make good if she has failed in this No excuses are accepted for failure of guns to fire, for breaking down of any gear or for any faults of the personnel or material The instant the target is sighted, the firing vessel must steam toward it at high speed and deliver her salvos in the shortest possible time

Part of the most important training is that given to the "spotters" both officers and men These are detailed in accordance with their skill at estimating distances at which the projectiles fall short or over the target at ranges of from 10,000 to 13,000 yards in the open sea They must show a very high degree of skill, for on their accurate judgment and their cool heads during battle, depend the life of the Fleet and of the Nation They are trained daily at "spotting boards," and at these drills the most skillful are selected to be further trained at the spotting practices where actual projectiles are used against an armored target At the recent spotting practice against the "San Marcos" in Chesapeake Bay it was found that salvos of eight projectiles fired at a distance of 11,500 yards could be placed on any part of the target ship

Though the gun pointers and the gun crews are perfect, their skill is of little value if the fire-control parties are not sufficiently well trained to estimate the proper errors in range and bring the center of impact of all projectiles on the target The demonstration against the "San Marcos" (ex "Texas") was one of the most remarkable exhibitions of team work ever shown in the Navy The theoretical number of possible hits at that range, if all conditions of temperature, atmosphere steadiness of platform, skill of gun pointers, etc., were perfect, was 45 per cent The detailed examination made by the special board showed definite evidence of 43 per cent of hits, the board further stating that so much of the ship was shot away, it might well be that many other projectiles hit the "San Marcos" without leaving a definite record

The prizes for gunnery work on elementary practice are of little value and in the annual battle practice each year, where the keenest interest is displayed by every officer and man in the fleet the only reward is a little piece of red bunting with a black ball in the center, floating proudly at the mast head of the winning ship



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This is the splash of 7-inch shells of "Connecticut" fired at 7,000 yards range.

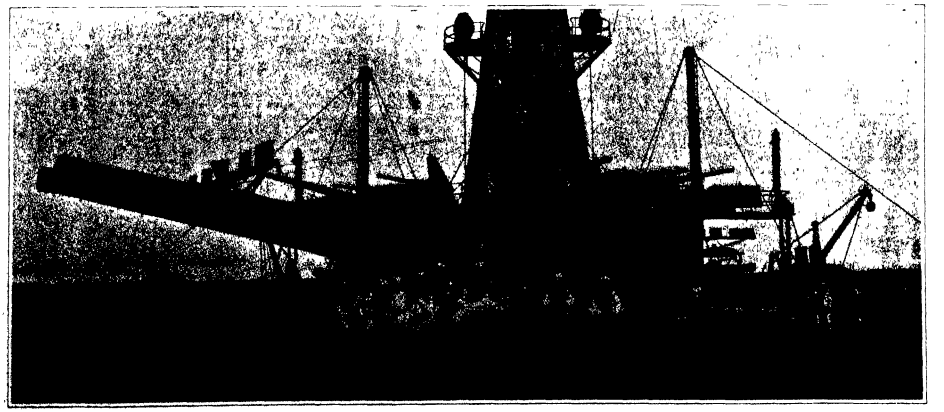
WATCHING FALL OF SHOTS FROM TOWING SHIP "MICHIGAN"



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Men of the "North Dakota" on the target raft removing the net for examination

REMOVING NET SCREEN FROM TARGET



Above the 12-inch guns is the Morris tube and mechanism used in training gun-pointers.

FORWARD TURRET OF THE U. S. BATTLESHIP "MINNESOTA"

A Landsman's Log Aboard the Battleship "North Dakota"—V.

"The Greatest Game in the World"

By J. Bernard Walker, Editor of the SCIENTIFIC AMERICAN



"And there, glasses on the target, his mouth at the telephone, is the man upon whom, more than any other, depend the fortunes of the day—the spotter. A natural aptitude and long experience enable him to judge with marvelous accuracy by how much the splashes of the shells are short or over, to right or to left of, the target."

"TELL you sir, it's the greatest game in the world" We were in the fore top of the 'North Dakota' which, having just completed the autumn practice with her 12 inch guns, was steaming in to take a look at the target The other occupants of the platform had disappeared through the trap door in the floor and only the Lieutenant who had done the spotting and I were left 'A great game, but dangerous, I suggested, 'no protection, ricochet shots, high explosive shells—these masts, if the enemy can shoot like the 'North Dakota' must come down early in the action" The officer was removing his telephone headpiece, he stopped, turned, and quick as a flash came the response 'Then it's the grandest way to die'" and as he climbed down the chain ladder, leaving me alone, the words of the old Roman passed through my mind Dulce et decorum est pro patria mori' (Sweet it is and altogether fitting to die for one's native land)

"Yes" I thought 'there is the whole story The greatest game—the grandest death—an epitome of the fine spirit of our navy'

How has it come about that this target practice, once a drudgery (I had almost said a joke), has become to the officers and men of our navy "the greatest game in the world"—great in the excitement and keen competition of the preliminary training, and great in all that it stands for as the final arbiter when peaceful means have failed, of the fate of a nation?

If the reader of this log would know, let him fellow me, this fine October morning as I squeeze through a door in the overhanging floor of No 3 turret, and then scramble down as best I may, until I stand on the double bottom of the ship 23 feet below the surface of the water and some 56 feet below the pair of 12 inch guns Here I find myself in a compartment 20 feet square Rising from its center is the base of the rotating turret structure attached to which, and turning with it, are two elevators or "hoists," whose shell and powder cars stand ready for loading Water tight doors lead from this handling room into several surrounding compartments At the invitation of the ensign who has charge of the crew I enter one of these compartments the shell room Here I see two after tier of the huge, 12-inch 870-pound shells resting in strong steel racks Overhead and leading out to the ammunition hoist is a trolley rail, carrying a traveling chain hoist Returning to the handling room, I enter another compartment in which, neatly stored in racks, are the powder charges each sewed up in a silk bag and inclosed in a copper case The walls of these compartments are heavily lined with asbestos, and refrigerated air circulates throughout them maintaining the ammunition at a constant, predetermined temperature

I am down here to witness the drill with dummy shells and dummy bags of powder of the same size and weight as the service shells and powder which for weeks past has been carried out daily as part of the ship's routine A dozen or fifteen men stand at their stations The shell-room door is open; within it the chain hoist hangs ready for service The powder-room door is shut, it has a circular opening, large enough for the passage of a bag of powder, which is closed by a hinged brass flap—this to prevent any accidental spark or fire from passing to the magazine

The ensign borrows my watch 'Load'" A shell is gripped and hoisted from the rack—three men push it, on the run, to the hoist—a catch is released, and the 870-pound mass drops with a crash into the car' Meanwhile three men grab, in succession three bags of powder, as they are thrust through the flap-covered hole in the powder room door, run with them to the hoist and drop them into the car, which, with a whirr, swoops up in a swift dash to the guns above

"Rotten'" shouts the ensign, "lads this will never do, you took 15 seconds, try it again" Down comes the car and the dummies are returned to their racks Some changes are made in the stations of the men "Load'" Another wild rush, in which a powder-bag man over-runs himself and sprawls, hugging his bag, causing the loss of a precious moment "Twelve seconds' that is better, but you won't beat the 'Delaware' at this gait Try again" Once more I see these eager young men (they are green hands—not many months ago they were at work on farm and in factory) standing tip-toe with eager excitement "Load'"—"Ten seconds' Bully, lads—that will do"

A day or two later, by the courtesy of the turret officer, I stood within this same turret during the firing with full service charges, on the target practice run My position was against the rear wall, immediately back of the right-hand gun To the right of the gun, at the front of the turret and immediately back of the sloping port-plate, 12 inches thick, stood the gun-pointer, his eye at the eye piece of a periscope, whose object glass was outside the turret in a little armored hood on the side wall The pointer's left hand was on a trigger If that missed fire, there was another close beside it Should that also fail, a foot-pedal would do the trick His work was to keep the horizontal wire on the target This he did by a lever in his right hand, which operated a powerful and wonderfully sensitive differential oil motor of variable speed Under his hand the muzzle of the gun rose and fell as though it were a shoulder piece instead of a 50-ton mass of metal The turret (and therefore the guns) was moved to right or left (trained) by a man whose position was between the two guns. He also was immediately behind the port-plate He grasped a wheel (much like an auto's steering wheel), and by a differential-gear motor moved the huge mass of the turret and guns, weighing several hundred tons, as swiftly and lightly as though it were a one-pounder. He also saw the mark through a periscope, and he steadily kept the vertical wire of his telescope on the center of the target

Back of our gun-pointer stood the sight-setter, telephone clamped over his ears To him, from the central station below the protective deck, came the "range" (elevation) and the "deflection" (corrections for speed of enemy, wind, side drift of shell due to its rotation, etc.). His duty was to turn a disk till the pointer stood at the range as announced to him; and to turn, also, a little cylinder, until it registered the proper deflection.

Back of the sight-setter was a lusty and powerfully-muscled young seaman, who grasped the handle of a crank, by which, through a worm gear, the massive breech-block was opened and shut Next to him was the primer man, with his rows of primers standing conveniently to hand in a case on the turret wall Immediately back of the breech-block was the turret captain To the rear of him sitting on one of a row of 12-inch shells, with his back against the rear turret wall, was I, gathering material for this log To my left was a junior lieutenant, in charge of the crew When I had last seen him he was in his immaculate whites and shoulder straps—now he was in dungaree trousers and a sleeveless undershirt To his left, in line with the bore of the gun, was the electric rammer To the left of the rammer was a man grasping the control of the electric motor that drives the rammer Ahead of him was another man, with his hand on the control of the ammunition hoist

A steel bulkhead separated the two guns and their crews, placed there so that an accident or a bursting shell in one compartment would not "rattle" the crew in the other In the extreme rear of the turret communicating through a small shutter in the door that led to each gun compartment, was a little room (booth) in which was seated the turret officer, a senior lieutenant He was in telephonic communication with the fire control officer (the executive officer in the conning tower, who under the captain, fights the ship) In front of him were some electric switches and cut-outs (normally open) which the turret officer closes on notification to be ready to fire Until he closes them the guns cannot be fired

We are now on the range The command is given to load. The young Hercules whirls his crank—the breech block opens—with a rush the ammunition car comes up from below, stopping with the shell opposite the open breech—the rammer jumps forward, thrusting home and seating the shell—the rammer returns—a bag of powder falls from the car in front of the rammer and is thrust into the open maw of the gun—then another, and yet a third—340 pounds in all Our young Hercules whirls his crank—again the massive breech-block swings into place, and all is ready for the 'buzzer," sounded from the conning tower, at whose notification the gun-pointer will send the shell on its long flight to the mark

Suddenly there came a clash and jar of the turret, not unlike the noise and shock when a train backs up rather briskly to couple up the railroad car in which one is riding; and the huge bulk of the gun jumps back some three feet, and instantly returns with a crash into battery (its normal position), the recoil occupying but a fraction of a second Then follows a blast of air—the compressed air-blast blowing the gases out of the gun—and the breech is open for the next loading.

Thus, with clock-like regularity we fired—six times in swift succession—and the run was over. At point-blank range, with no delay in waiting for the spotter's corrections, these 12-inch guns can be fired three times a minute.

I heard very little of the report of the guns—I was to hear that from the fire-control platform on the next run Outside of the railroad-coupling shock and the swift recoil and return of the gun, there was nothing to tell me that, at each discharge, 50,000 foot-tons of energy had been let loose within a few feet of me—enough to lift that gun 1,000 feet into the air!

Then I left the turret, went forward and climbed the chain ladder that zig-zags inside the forward cage mast and lets you through a trap door onto the fire control platform Just here, in passing, let me tell you, fellow landsmen that if you wish for a really novel sensation in climbing, you can get it when swinging 100 feet in mid air from an abominably flexible chain ladder, from which you look down into the black hell mouth of a smokestack that is doing its best to destroy your fast-expiring sense of balance by belching at you large volumes of hot furnace gas

But, once arrived at the coveted perch—what a spectacle! Below is the good ship 'North Dakota,' her deck turrets and guns seen in plan, and looking curiously like those line-cut deck plans of Uncle Sam's ships which you and I have seen at times on the pages of the SCIENTIFIC AMERICAN All around and gently convexing to the far horizon, is the sea—"calm as" the proverbial "mill pond"—reflecting in deeper tone the glorious blue of the cloudless heavens And there some seven miles away, is the target—a tiny dull-gray patch, doing its 10 knots some 350 yards astern of the towing ship

The platform is roomy, eight by twelve feet, I judge What I see is typical of what I saw on other ships Here, an officer is telephoning the compass readings to the fire control station below decks Another stands at the range-finder and calls into his mouthpiece the automatically recorded distances to the target A seaman at a kind of typewriter arrangement presses buttons, which serve to display the range in big numbers on the under side of the platform

Here stand the umpires from other ships, and there, glasses on the target, his mouth at the telephone, is the man upon whom, more than any other, depend the fortunes of the day—the spotter A natural aptitude and long experience enable him to judge with marvelous accuracy by how much the splashes of the shells are short or over, to right or to left of the target

The speed is raised to 15 knots we are closing in to the minimum range, for reduced charges, 9,000 yards We may go closer than that, but if we do the results will be penalized In monotonous tone the ranges are called off, 11,000 yards, 10,000, 9,700, 9,200 and then 9,000 I look over the breast high rail at the guns, when suddenly there comes the flash of the first ranging shot Fifteen seconds or so later there is a splash at the target, which, to my unaccustomed eyes, appears to be but a few feet in front of it and, surely, at its very center I am wrong, for I hear the spotter call into his mouthpiece "Two hundred up—two left," which means that the shot has dropped 200 yards this side of the target and two "knots" or say about 40 feet to the right of the mark

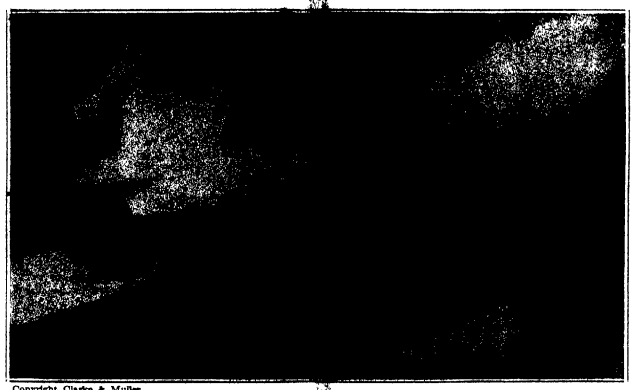
Down to the central station and thence to the gun, go the corrections Mentally I can see the sight-setter adding 200 yards to the elevation and 40 feet to the deflection But there goes another gun followed by another cry of the shell, and another splash, this time beyond the

(Concluded on page 532)



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"Later, a four-gun salvo went clean through the target, tearing a large part of it away and throwing up the characteristic pale columns of water just beyond."



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"The plate herewith shown bears dramatic evidence of the power of the mighty gun blast. The photographer had the temerity to stand on the forward bridge of the 'Michigan,' to take a four-gun salvo. After the discharge, he lay on his back, his camera smashed, but his picture saved, except for the diagonal crack, which is visible on the plate, running from left to right - mute evidence of the mishap."



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"Later in the day the wet screen which covered the target was brought on board, where it was carefully combed over by the umpires, the ordnance-officer, and the spotter, who searched every square foot of it, looking for the coveted ragged hole, with as much care as a prospector looked for a color of gold in his pan."



"Here, an officer is telephoning the compass readings to the fire-control station below decks Another stands at the range-finder and calls into his mouthpiece the automatically-recorded distances to the target. A seaman at a kind of typewriter arrangement presses buttons, which serve to display the range in big numbers on the under side of the platform."

The Modern Submarine

A Seaworthy and Deadly Craft, Which May Ultimately Dominate Naval Warfare

By Lieut. D. C. Bingham, Assistant Director of Target Practice, Etc., Late Commander Third Submarine Division

THE influence of sea power on the rise and fall of governments is well understood. In the most sea power has been won and held by vessels that cruised and fought on the surface of the seas, and the logical outcome is the enormous displacements of the fighting ships of all countries. Within the last decade three weapons of warfare, which in future struggles for the control of the seas are to be of great importance, have been undergoing development. These three weapons are the automobile torpedo, the submarine and aero-craft. Too much stress cannot be laid on their influence on sea power; the submarine carrying the automobile torpedo as the destructive agency, the aero-craft acting as a scout.

A number of erroneous ideas exist in regard to the modern submarine, which prevent a thorough understanding of that type of vessel—its achievements and its future development. A few of the causes and conditions producing the above result will be dealt with briefly.

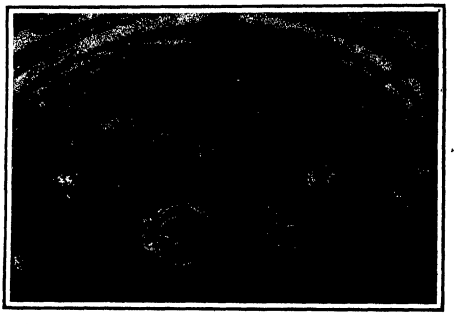
The policy of secrecy that has been maintained in the development of the submarine has led to its being looked upon as something mysterious. So long as the popular idea of a submarine is one of mystery, just so long will it fail to receive the recognition it deserves. Many unreasonable claims are made for new inventions, even those barely out of the experimental stage, and the submarine has not escaped, although now it has passed beyond the experimental stage, a fact which the progressive programmes of construction, especially in Great Britain, prove most conclusively.

Those who do not know the submarine quickly bring to your attention certain dangers to which it is exposed, that are supposed to make it as much of a menace to itself as to other vessels. These dangers are generally grouped under the head of "explosions" and "collisions." A few moments' reflection will reveal the fact that these risks are not peculiar to the submarine, except in the case of a collision when the submarine is rising from a complete submergence. These dangers are avoided by submarines in the same way as by surface vessels, although there is more care exercised aboard the submarine than on any other type of vessel. The danger of explosion lies in the storage battery and the fuel oil, which are the sources of power respectively for submerged and surface cruising. Thousands of power boats, automobiles, etc., use gasoline without fear, and the same is true of the storage battery except as to numbers. The danger of collision is no greater for the submarine than for surface craft, except in the case when the submarine is changing its depth from sixty feet or more to one of about twenty. At sixty feet the submarine is clear of the hulls of shipping, at twenty the shipping can be observed through the observation tubes, or periscopes. The time to rise from sixty feet to twenty is but a few seconds, and before the ascent is made it is the practice to carefully "listen in" on the submarine bell receivers for the noises made by the propellers of passing vessels, and a submarine commander is almost assured that no danger lies above before changing depth. Even the danger from collision is not so great as is generally supposed. The submarine may be divided into compartments, any one of which may be flooded without destroying the flotation, furthermore, being built to run under the surface, it is stronger in construction than those vessels designed solely for surface cruising.

The phrase, "The Mother and her Chicks alongside," which often appears in the press cannot fail to leave an impression of weakness and helplessness. The battleship divisions of the Atlantic fleet to-day do not assemble without their repair ships, supply ships, colliers, tugs, and tenders, all of which are "Mothers," and as an effective force they cannot move away from the coast without them.

Diving to avoid collision has its share in building up the mysterious atmosphere about the submarine. It sounds well as a subject of conversation and gives a thrilling touch to a story, nevertheless few submarine commanders ever consider that method of avoiding imminent collision.

During the last half century the advance in hull construction and in propelling machinery has made of the submarine a vessel that can cruise and maneuver on the surface, that can change its depth of submergence with safety and rapidity, and that can readily maneuver submerged. Its tanks, to which water is admitted when a submergence is made, are constructed to withstand the pressure due to a depth of two hundred feet, and they are fitted with simple and quick means of admitting and discharging the water. Air pressure and large pumps driven by electricity are generally used when it is desired to free the tanks of water. Compressed air is carried in strongly constructed tanks for expelling water from the tanks and for renewing the air in the vessel during a submergence, although air renewal is not necessary for runs of under three or four hours' duration. The motive power on the surface is the fuel oil engine, under the surface it is the electric motor driven by the power of the storage batteries. In making passage from one point to another the modern submarine uses the same methods appliances, landmarks, etc., as surface vessels. When cruising submerged with the tops of the periscopes exposed, the methods, etc., are the same, except that the bearings and observations are taken through the periscope, and when totally submerged the conditions as regards vision are the same as those aboard a surface vessel cruising in a fog, as it is impossible to see more than a few feet through the waters of the sea. The depth under water is registered on a number of water-pressure gages, and there is never any doubt as to the distance of the vessel from the surface.



In the center are the two torpedo discharge tubes. To the left is the electric motor and gear by which the doors in the nose of the submarine are opened for discharge of torpedoes.

INTERIOR VIEW ON MAIN FLOOR OF SUBMARINE "NARWHAL"



View looking forward from the bridge, showing the ample deck space.

THE SUBMARINE "NARWHAL" MAKING 14 KNOTS AT THE SURFACE

The operation of making a submergence in the modern submarine is comparatively simple and is readily understood. First, the upper deck is cleared of bridges, life lines, etc., although in time of war and maneuvers this gear is not rigged. This material is stowed inside of the submarine and can be unrigged within eight minutes. Second, the vessel is completely sealed; an operation that requires only a few seconds. The large holes in the hull are covered by doors with rubber fittings and are made watertight by the throw of a lever, the smaller holes are closed by a turn of a valve handle. Third, water is first admitted to one or more large tanks to destroy the major part of the floating power of the vessel, then to the tanks forward or aft to level her, and finally to tanks in the center of the vessel. The water admitted to the last tanks does not materially change the inclination of the vessel, and it is admitted in small quantities until the floating power is reduced to from six hundred to a thousand pounds. Gages record the results of each stage. The submarine in this condition exposes about ten feet of her periscopes and is ready for running submerged. The electric motors are then started, and the resistance of the water acting on horizontal rudders and the deck, forces the submarine below the surface. The desired depth is obtained by giving the proper inclination to the rudders and the vessel. In fact, the control of the submarine in changing and maintaining its depth is very similar to the control of a surface vessel when making a passage on the surface. The modern submarine, starting with its main tanks free of water, can totally submerge within three minutes. Such a weapon is not and cannot be a mystery.

What the Submarine has Accomplished.—The record of the "Davide" before Charleston during the civil war, when a blockading squadron was kept on the move for over a year, three ships injured, and a

urth sunk, proved at that early date the value of the submarine. The radius of action of the "Davids" was limited, that of the modern submarine is almost unlimited. The Division of Submarines now in commission on the Atlantic Coast was actively engaged in cruises, maneuvers, and target practices, from March 1st to November 1st of this year. During that time the Division cruised from Annapolis, Md., to Portsmouth, N. H., and familiarized itself with all harbors along the coast. The harbors of Chesapeake Bay, those of Newport, Provincetown, Boston, Gloucester, Rockport, Portsmouth, and Vineyard Haven Sound were successfully navigated by the submarines in the submerged condition, and, at times, much to the surprise and astonishment of the unsuspecting shipping. The submarines were often separated from the tenders for periods of two to four days and severe weather conditions of gales, snowstorms, and fog were encountered. As the conditions were successfully met from time to time, officers and crews gained confidence in the reliability of the weapon placed in their hands.

While the Division was in the waters of the Chesapeake, three- and four-day cruises away from the tenders were made for the purpose of thoroughly developing the crews. On one of these cruises a gale, accompanied by snow and hail, struck the Division when at anchor in the lower Chesapeake. The blow continued throughout the night and the following day. Two submarines lost their anchors and were forced to keep under way throughout the night, the others rode out the gale without experiencing any serious trouble. All returned the following day to Annapolis against high head winds and seas, that covered the vessels with frozen spray from the tops of the periscopes to the water lines. The ice-covered submarines were such beautiful marine pictures as they came into the harbor that the discomforts of the run up the bay were soon forgotten.

Nantucket Sound and the waters of Massachusetts Bay were repeatedly navigated in fogs. During the operations in Cape Cod Bay, twenty to thirty torpedo vessels, submarines, and surface craft would enter Provincetown harbor at night and in dense fogs. In due course of time after such an exercise, the wireless would flash the signal that all vessels of the submarine Division had returned. The most successful cruise of the Division in a dense fog was a run in close formation from the inner harbor of Gloucester to that of Provincetown without any navigation landmarks having been sighted, and except for a few minutes, the submarines were not visible from one another, although they were less than 100 yards apart. The Division had spent the week-end at Gloucester and the run was made in order that it might report ready for the night attacks on the battleships.

A run, that in many ways simulated war conditions, was made during June from Newport, R. I. to Gloucester, Mass., when practically the entire distance of 190 miles was made by the submarines in the submerged condition. Two stops were made, one at the entrance to Nantucket Sound, the other at Provincetown. The longest time of any one submergence was about twelve hours, and the greatest distance submerged on any one run was about fifty-five miles. During the entire run the submarines were separated from the tenders and were self sustaining in every respect. Less than sixty hours were taken for the run, although no attempt was made to make a record. The battleships, the torpedo craft, and naval militia engaged in combined maneuvers off Newport from July 18th to 20th. The part assigned to the submarine Division approached war conditions almost perfectly. All harbors from Gay Head to Montauk Point that could be used as bases by an invading fleet had to be protected. The disposition of the seven submarines was made accordingly, and they were successful beyond the expectation of the most enthusiastic. In the day problem two succeeded in attacking before the battleships anchored, the others within three hours after they had anchored. In the night attack the invading force pierced the line well to the eastward and only two submarines were successful. The exercise was declared finished before the submarines at the entrance of Long Island Sound had time to come up. The readiness with which the modern submarine can deliver an attack was vividly demonstrated on the morning of the 19th. At 3.40 P. M. on July 18th the "Grayling" anchored on the outer line between Block Island and Gay Head, ready in every respect for quick work. At night lights were screened and a watch of three set. At 4.10 A. M. of the following morning the lookout reported an armored ship to the southward and eastward, distant several miles, and standing to the northward. "All hands" were called at once, hammocks lashed and stowed, thirty fathoms of anchor cable hove in and anchor secured, and preparations made for running submerged. At 4.24 A. M., just fourteen minutes from the time of receiving the first report, the "Grayling" was submerged and running at seven and one-half knots to intercept the armored ship, which proved to be the scout "Washington." At 4.58 A. M. an attack was delivered. The scout was then standing rapidly to the eastward but later returned, and another attack was delivered. After the second attack the "Grayling" rose to the surface in order to impress the scout with the utter folly of carrying on scouting operations so near the enemy's coast. The operations of July and August in Cape Cod Bay were a continuation of the successful work in the sham battle off Block Island.

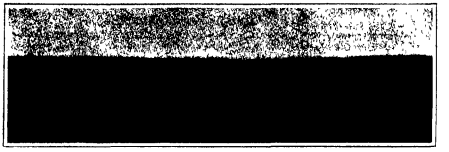
A method of attack developed by the "Narwhal" and "Grayling" off Gloucester is worthy of note as showing the reliance that can be placed in the modern submarine. The "Narwhal," cruising at depths of from seventy to one hundred feet directly under the "Grayling," which was submerged to a depth of fifteen feet, was directed by the "Grayling" for over two hours. The speed of both vessels was seven and one-half knots and the means of communication was the submarine bell apparatus. When the "Narwhal" rose to the surface in obedience to a signal from the "Grayling" she was in her designated position.

The mobility of the Division is shown by the distance cruised during the eight months away from the navy yards viz. 25,000 miles on the surface and 3,800 submerged. The achievements have been accomplished with submarines developed by a commercial company and it is reasonable to suppose that they will be greater when their development is undertaken by the navy.

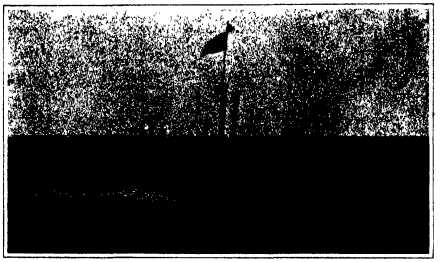
In view of what the submarine has done can anyone doubt its future?

The Submarine Compared to Other Types of Warships.—The essential military characteristics of a man-of-war are, seagoing and sea-keeping qualities, invulnerability and powerful and destructive armament. A man-of-war to be seagoing and sea-keeping must be seaworthy and habitable in all condition of weather and sea, its motive power must be reliable, it must be readily handled and maneuvered, and it must have a large radius of action. The modern submarine is built to stand the great pressure due to 200 feet submergence,

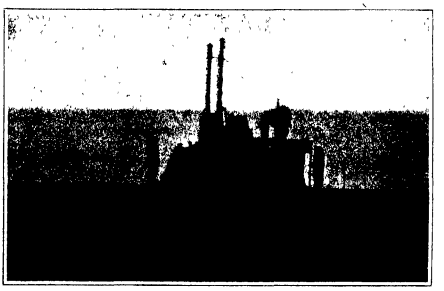
(Continued on page 656.)



Running submerged, conning tower awash.



The diving rudders are depressed, causing the boat to dive



Knocking down and sending below bridge and deck fittings, preparatory to submerging.



At the surface, showing conning tower, bridge and periscopes.

The Fleet and Its Readiness for Service

(Continued from page 581)

Vessels Built

[March 1, 1911]

	Battleships, Dreadnought type[1]	Battleships[2]	Armored Cruisers, Invincible Type[3]	Armored Cruisers[4]	Cruisers[5]	Destroyers	Torpedo Boats	Submarines	Coast-Defense Vessels[6]
England	8	47	4	34	81[8]	176	59	68	
Germany	4	32	1	9	41	81	35	8	6
United States	4			12	30	30	18	5	
France		17		21	12	65	25	9	8
Japan		11	2	11	16	57	59	9	3
Russia		9		7	11	37	45	31	2
Italy		9		10	7	23	58	7	
Austria		5		3	6	14	47	6	6

[1] Battleships having a main battery of all big guns (11 inches or more in caliber).

[2] Battleships, first class: are those of (about) 10,000 tons or more displacement.

[3] Armored cruisers having guns of largest caliber in main battery and capable of taking their place in line of battle with the battleships. They have an increase of speed at the expense of carrying fewer guns in main battery and a decrease in armor protection, also called battleship cruisers.

[4] Include all unarmored cruising vessels above 1,000 tons displacement.

[5] Includes small battleships and monitors. No more vessels of this class are being proposed or built by the great powers.

[6] Includes vessels of colonies.

Vessels Building or Authorized

[March 1, 1911]

	Battleships, Dreadnought Type	Battleships	Armored Cruisers, Invincible Type	Armored Cruisers	Cruisers	Destroyers	Torpedo Boats	Submarines
England[1]	10		5[2]		18[3]	80[3]		18[3]
Germany[4]	9		3		4	16		12[3]
United States	0					12		16
France	2	5		1		30	2	9[3]
Japan[5]	2				5	4		6
Russia	4					4		6
Italy	4				4	10	50	13
Austria	2[6]	1						6

[1] England has no continuing ship building policy but usually lays down each year 5 armored ships, with a proportional number of smaller vessels.

[2] Includes 3 vessels of colonies.

[3] Germany has a continuing shipbuilding program governed by a fleet law authorized by the Reichstag in 1911 there are authorized 3 battleships, 1 armored cruiser, 2 cruisers, 12 destroyers. Eventual strength to consist of 28 battleships 20 armored cruisers, 38 cruisers, 144 destroyers.

[4] $7,550,000 authorized for experiments and further construction.

[5] One more battleship, 2 more armored cruisers, 1 more cruiser and several destroyers and submarines authorized to be laid down and completed by 1916.

[6] Building under agreement with navy department before authorization by legislatures.

NOTE. The following vessels are not included in the tables. Those over 20 years old unless they have been reconstructed and rearmed since 1900; transports, colliers, repair ships converted merchant vessels or any other auxiliaries vessels of less than 1,000 tons except torpedo craft, torpedo craft of less than 50 tons.

A Landsman's Log Aboard the Battleship "North Dakota"—V.

(Continued from page 574)

target. "One hundred down," says the spotter. "What next?" I ask of an officer standing near me. "A six-gun salvo—have you got your ear-protectors in place?" I am raising my hands to press the little bulbs more snugly in position, when there bursts forth a Titanic crash! My whole frame feels as though some unseen hand had struck it a violent blow, and I find myself flung, in the effort to keep my footing, entirely across the platform in the direction of the target (the effect of the recoil) and then flung backward, and then alternately forward and backward, until the fierce whipping of the *mast subsides*.

The spotter looks over his shoulder at me and points at the sky and there I see six, sharply-defined, circular, black spots, symmetrically disposed, in pairs, on a long horizontal line across the heavens—the six shells.

"Baron Munchausen?"

Nay, good reader, question not my veracity, it is a common phenomenon and may be seen at any big-gun target practice when the weather is clear, as it was that day. Steadily, the little ink-black spots diminished and drew together under the influence of the perspective, rising gradually to the highest point of their trajectory, when they faded from sight.

The fire-control platform has quickly steadied to absolute quiet, and we listen with keen attention for the spotter's verdict. Up go those magnificent, flashing bursts of pulverized water, and I hear the spotter call into the mouthpiece: "A straddle," which means that some of the shells have dropped in front and some beyond, making the average of the whole six a hit on the target itself.

Later, a four-gun salvo went clear through the target, tearing part of it away and throwing up the vast tell-tale geysers just beyond.

The physical effect of the blast of these 12-inch guns is something that defies description; but the plate shown on page 583 bears dramatic evidence of the power of the mighty air-wave. The photographer had the temerity to stand on the forward bridge of the "Michigan" to photograph a four-gun salvo from turrets 1 and 2. After the discharge, he found himself on his back on the after side of the bridge, his camera smashed to fragments, but his picture saved, except for the diagonal crack which will be noticed in this illustration, running from left to right—mute evidence of the mishap.

Dramatic in every way is a salvo of the main batteries of a modern battleship. Its appeal to the eye may be judged from the handsome photogravure insert which is inclosed within the present issue.

Later in the day, the net screen which covered the target was brought on board, where it was carefully combed over by the umpires, the ordnance officer, and the spotter, who searched every square foot of it, looking for the coveted ragged rents with as much care as ever a western prospector looked for a color of gold in his pan. The four-gun salvo that carried away a part of the target cost the "North Dakota" dear; for a considerable portion having disappeared, by the rules of the game, and indeed by the necessities of the case, any later shots that may have passed through the gap did not count. For this and other reasons, I could not understand the disappointment of that ship's company when they learned the result—*four hits and six ricochets*. Credit should be given for the fact that since for economy, three-quarter powder charges were used, the sight-bar range was actually about 13,000 yards, or between six and seven miles. To me at least this was a fitting and altogether satisfactory climax to that never-to-be forgotten cruise aboard the "North Dakota."

If the present log has served to give the people of the United States a clearer knowledge of the fine work which is being done in the United States Navy, not only by the "man behind the gun" but also by the man behind "the man behind the gun," it will not have been written in vain.

The landsman's thanks are due to George von L. Meyer, the Secretary of the Navy, to Admiral Hugo Osterhaus, Commander-in-Chief of the Atlantic fleet, and to Capt. Albert Gleaves and the officers of the good ship "North Dakota" for the many courtesies extended during my stay with the Atlantic Fleet on the South ern Drill Grounds.

(*End of Landsman's Log. For earlier chapters see issues of October 14th and 28th and November 11th and 25th.*)

Our Rank Among the Naval Powers

(Continued from page 581)

increase the number of merchant vessels flying the American flag, the navy will have to depend upon its own colliers in time of war, or purchase or charter merchant vessels in foreign countries—probably the former, as the risks under charter would be considered too great. Such a procedure would be most uneconomical, as greatly increased prices would no doubt be demanded, our needs being known.

In the event of actual hostilities, the supply of ammunition to a fleet is the most important factor. The battleships of the present day carry ordinarily about 100 rounds for each of the heavy guns. In the event of hostilities by stowing magazines and shell-rooms to their fullest capacity, this amount would probably be increased to about 120 rounds per gun.

When we take into account the rapidity of fire of the heavy guns of a modern battleship, and the range at which an action will begin, it would not seem improbable if the total amount of ammunition would be shot away in an engagement with an enemy without either fleet gaining such a marked advantage as to make the action decisive and final.

If such action takes place in close proximity to the shores of the enemy, it would not be very difficult for its fleet to withdraw temporarily to a fortified basis and replenish rapidly its magazines and shell-rooms. The question presents more formidable difficulties for a fleet operating at a great distance from a base. Ammunition must be carried to the fleet in properly equipped ammunition ships, ships so fitted as to be able to rapidly discharge their ammunition into the battleships. Arrangements can be made by which a limited amount of ammunition can be carried by all auxiliaries, including colliers, supply ships, repair ships, transports, etc., but these ships must be especially fitted for carrying the ammunition, and at the best can carry but a limited quantity.

Other necessary adjuncts of a well balanced fleet are repair ships, hospital ships, transports and mine laying vessels.

Repair Ships.

It is believed that if any fleet is accompanied by a sufficient number of properly equipped repair ships, it will be necessary for said ships to visit our dock yards only at very distant intervals, primarily for cleaning their bottoms. Numerous small accidents to the machinery or appurtenances of a modern battleship can be readily and efficiently repaired by a properly equipped repair ship. After an action between two fleets, the value of a repair ship cannot be over-estimated. Many ships of the fleet may be damaged in such a way that they can be temporarily repaired and fitted to take their place again in the line of battle by a repair ship.

The United States possesses but one ship of this type as opposed to three in England and two in Germany, and while the Merchant Marine of this country may possibly furnish a number of ships suitable for this purpose, time will be required to install in such ships a proper equipment.

Hospital ships, while a necessary adjunct to the fleet, can undoubtedly be acquired by purchase or contract of vessels under the American flag or in foreign countries, as said vessels act under the Red Cross Agreement and are not to be considered as subject to capture so long as they perform the duties for which they are designed. Transports for the conveying of bodies of troops and advanced base outfits can probably be acquired by purchase or contract preceding hostilities, and will probably only be needed in the event of distant operations of the fleet, where it becomes necessary to seize and defend a base, to which vessels of the operating fleet can repair at intervals for coal, fuel, ammunition, or other supplies.

Submarines.

In the present state of naval development, the submarine is essentially a vessel designed as an important part of the mobile defenses of our coasts or outlying possessions. It is understood that the French Government is now designing and building a type of submarine, which it is believed will be able to accompany the fleet even in distant operations, its radius of action and habitability having been developed to the extent which makes such a use of this type of vessel a probable success. Of this type, the submarine, England possesses seventy-four, Germany fourteen, United States twenty-six, France sixty-six, Japan ten, and Russia thirty-one.

Personnel.

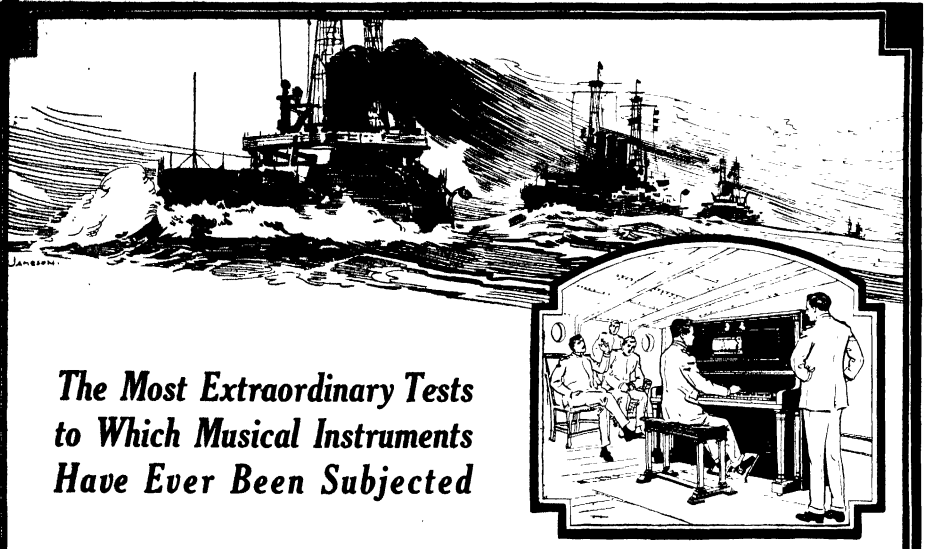
When we come to consider the number of commissioned officers and enlisted men available for duty in the fleet, we find that the United States Navy is sadly deficient. Although the number and size of our vessels of war have increased very largely in the last ten years, there has been no proportionate increase in the commissioned personnel of the Navy. If the Navy Department were called upon to-day to commission all of its fighting vessels now in reserve, and which, in the event of war, it would be necessary to place in service, it would be impossible efficiently to officer and man these vessels. Of late, when it has been found necessary to commission some new battleship cruiser, or even torpedo destroyer, it has been found equally necessary to place some vessel of the same type in reserve or out of commission, in order to provide the personnel for the new ship.

It is difficult to compare conditions between countries which have compulsory military service and countries where service in the navy is purely voluntary. England, although compulsory military service does not exist, maintains a very strong reserve of both officers and men. In all other European navies compulsory service exists, so that these countries are from year to year building up a reserve of officers and also of trained men, who have served at least three years with the colors.

In Germany this is a most important factor, as with their system, which carries a man along either in active service or in the reserve until he reaches the age of 45 years, a very large body of trained men is available, in the event of hostilities, for commissioning all ships in reserve, or for other purposes. So far as the commissioned personnel of the United States Navy is concerned, it compares most favorably in education, training and experience with that of any other country, but in numbers it is wholly inadequate for the present and future needs of the Navy.

The analysis of the composition of the various fleets, by which their strength and relative rank is measured, shows that Great Britain holds, beyond a shadow of a doubt, the first place. Considering the navies of the United States, Germany, France and Japan, it is clearly seen that the United States outranks France and Japan, as the superiority of our battleship fleet is so great as to offset every advantage they may possess in the other elements which make up naval strength.

To establish the relative positions of Germany and the United States is more difficult. Our only superiority lies in the battleships themselves; in all other essentials of fleet strength, we are outranked. Giving due weight, however, to all factors, it would seem that at the present writing the margin of superiority rests with our fleet, a margin so slight that, considering vessels building and authorized, two or three years will undoubtedly relegate the United States to third place among the nations.



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During target practice in Magdalena Bay and at Manila every object on board was subjected to terrific strain. In one instance, the force of concussion as the big guns were fired, was sufficient to bend in the steel bulkheads of one of the mess-rooms, where a Stuyvesant Pianola Piano was installed.

In two cases, during the storm encountered between Manila and Yokohama, Pianola Pianos broke loose from their fastenings and were hurled to the other side of their mess-rooms, before they could be secured.

Yet the Pianola Pianos in these rooms when examined four months later needed only slight adjusting and were very little out of tune.

These Pianola Pianos were the common property of the different messes to which they belonged. They were not played by one or two people as would be the case in a private home, but were used by anywhere from a dozen to a hundred or more different individuals.

According to the testimony of the officers and men, the different Pianola Pianos were played almost continuously during the whole fourteen months of the cruise, and shared with the big guns the interest of all visitors who came aboard.

On the return of the fleet, a special representative of the Aeolian Company was sent to Old Point Comfort to inspect these instruments. *Without exception every Pianola Piano examined was found in excellent playing order.*

Besides tuning and such slight regulation as fourteen months constant use would naturally involve, they were practically in *as good condition as when the fleet departed.*

* * * * * *

It is of the utmost importance that the distinction between the Pianola Piano and other so-called Player-pianos be understood. Only pianos containing the genuine Pianola and bearing the word "Pianola" upon the fall-board are Pianola Pianos. In the means it provides for artistic playing—in its musical quality as a piano and in its durability as assured by the thoroughness and fidelity of its construction—the Pianola Piano occupies a class apart from, and superior to all other instruments of its type.

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Recent Development in Ordnance

(Concluded from page 581)

Armor.

There has been no important advance in quality of armor since the Krupp process of hardening was introduced about fourteen years ago, during this period the side armor belts of our battleships have been of from nine to eleven inches thickness To meet the increasing power of guns and penetrative effect of projectiles, a tendency toward increasing this thickness to twelve or thirteen inches is evident, and the Bureau of Ordnance has even had one experimental eighteen-inch plate made and tested with a view to possible future demand for armor of that thickness

That the art of armor making has not stood still, in spite of there having been no radical changes in methods is shown by the two photographs on page 520 The former shows an armor plate produced in 1905, and the latter a plate produced in 1911, against each of which three projectiles have been fired In the one case the flaking of the hard surface was excessive, in the other almost nil It will be noted that neither plate was completely penetrated

This plates, which are not technically classed as armor, have been much improved in resisting power by changing the alloy used, a nickel-chrome-vanadium alloy has been adopted, and this when specially treated produces turret and conning tower tops of great resistance

Experimental Work.

Much valuable information has been obtained by experimental firing at the U S S "Katahdin" and "San Marcos" (formerly "Texas") Each of these is a vessel of small military value, but capable of affording an actual target for experimental firing The "Katahdin" was fitted with armor plate targets erected on her upper deck, one target represented the side of a battleship, the other a turret barbette, and in both the armor plate was braced by appropriate framing and structures Firing was conducted with a 12 inch gun on board the U S S "Tallahassee" at ranges of 7,700 to 8,500 yards, using service ammunition, but not with explosive shell, as the object was solely to determine penetrative effect Two hits were scored on each target with resultant complete penetration of the armor, as was expected in accordance with theoretical calculations The results of this test also proved that a projectile while in flight is at all times tangent to the trajectory

The 'San Marcos' furnished a target for more extensive firing the greater part of which was conducted by the U S S "New Hampshire" for purposes of gunnery training of the personnel The most striking lessons of this firing were

(1) The fact that, at ranges of 10,000 and 12,000 yards, the "New Hampshire" could place her shots on any portion of the ship at will, thus proving the accuracy of her spotting and pointing

(2) The tremendous havoc wrought in the "San Marcos" by the passage or bursting of entering shell

Modern Submarines

(Concluded from page 581)

therefore it is apparent that none of the surface elements can damage it Its natural subdivision into tanks for submerging purposes gives it a safety which every surface craft strives for by putting in double bottoms There is no smoke, no leaky or hot steam pipes, or any other of the numerous disadvantages of the ordinary surface vessel The reliability of the motive power, the internal combustion engine, is assured, and the modern submarine being a twin-screw vessel is readily maneuvered The radius of action of submarines now under construction exceeds 5,000 miles on the surface and 100 submerged, the maximum speed on the surface being 13½ knots, that submerged 10½ knots Ten miles is the farthest that a submarine can be seen on the surface, and its submerged radius of action is such as to permit many hours of maneuvering unseen and unsuspected, beneath the surface The comfort of the crew depends entirely on the weather and sea as it does in all craft. The submarine may escape from heavy weather

(Continued on page 585)

LEGAL NOTICES

PATENTS

If you have an invention which you wish to patent you can write fully and freely to Munn & Co for advice in regard to the best way of obtaining protection. Please send sketches or a model of your invention and a description of the device, explaining its operation.

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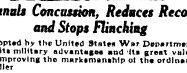
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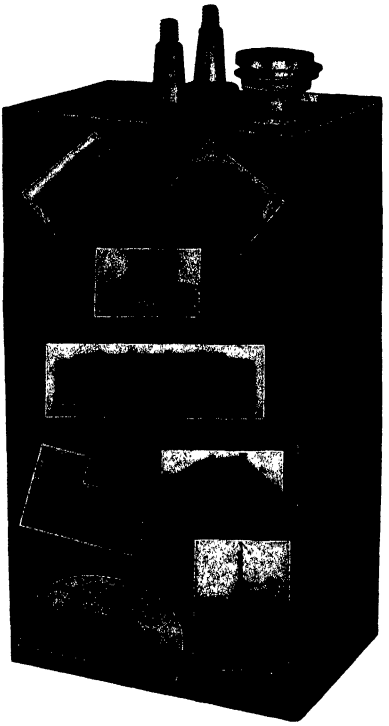
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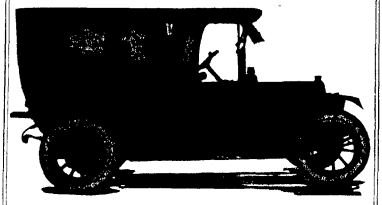
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Big companies, like big men, don't make many big mistakes.

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This is only natural, for the American Locomotive Company is itself a big company. Capital $50,000,000. And of considerable transportation experience—dating back to 1865. Builders of 50,000 locomotives.

Knowing this, these big companies felt that the American Locomotive Company *ought* to build a good truck. It had experience no one else possessed, extensive capital, large physical equipment, an organization already at work. Whether or not it really *had* built a good truck must be determined by actual service.

This was the logical reasoning upon which nearly every single big company made its *first* Alco purchase.

And since its first purchase every single big company has ordered *more* Alco Trucks! Every single one!

And sixty-two per cent of all Alco Trucks were purchased on such repeat orders!

In the service of Department Stores 78 per cent are re-orders; Oil Refiners, 74 per cent; Express Companies, 64 per cent; Packers, 53 per cent; Brewers, 50 per cent—the five lines of business in which motor trucks are most used today.

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These are compelling facts. They tell the smaller business man that he can avoid an unwise purchase if he selects the Alco.

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by remaining under the surface. This was actually done by the "Snapper" in 1916, when she remained on the bottom off Boston Light Vessel in seventy feet of water for 12½ hours.

The invulnerability of the submarine is well nigh perfect. In its approach, after sighting the enemy, its invisibility affords better protection than any armor or watertight subdivision that has been put abroad in surface vessel. The exposure of as much as five feet of one or more periscopes, each six inches in diameter, is necessary, in an attack, for periods of two to five minutes, although with that amount of the periscopes exposed there is still fourteen feet of water over the hull, which is ample for protection.

The armament consists of the torpedo tube and the torpedo. History teaches that the gun has always decided the naval battle, and admitting that to be true, may there not be a change in the character of the gun? It is a very simple matter to designate a torpedo tube as a gun and a torpedo as a projectile. In fact the similarity is so marked that it is surprising that they were not so named at the beginning.

Let the world become imbued with the belief that in the modern submarine there is nothing wonderful, weird, or unusual, and that duty aboard is not a hazardous undertaking, and a new era in the development of naval warfare will have commenced.

A Geographical Excursion Across the United States

IT is announced that the American Geographical Society, which celebrates its jubilee next year, is planning in connection therewith a transcontinental excursion for the purpose of geographical study, in which delegates from the geographical societies of other countries will be invited to participate. The party will be "personally conducted" by Prof W M. Davis, of Harvard, who has lately had experience in carrying out similar undertakings in Europe. It is expected, also, that the American members of the party will, so far as they are able, act as guides for the foreign visitors. While the natural features of the landscape are to be the principal objects of observation, attention will also be paid to the agricultural and industrial development of the country.

It is expected that the excursion will leave New York some time in August, 1912, on a special train, and will spend six or seven weeks in traversing the country. The itinerary, as now planned, is to include, among other points of interest, the highlands and gorge of the Hudson, Niagara, the shore-lines of old lakes in Ohio, the southern end of Lake Michigan, with its artificial outlet into the Mississippi system, the upper Mississippi and Missouri, the Yellowstone Canon and National Park, the Rockies of southern Montana, the Cascade Range, Seattle, and Puget Sound. The return will probably be made by a southerly route.

Fishing With a Steam Pump

ONE of the most singular fishing devices imaginable was discovered by accident in France. Though extremely simple, the system is revolutionary.

A pond on the farm of La Marlequette, bordered by rocky shores, was drained one year by the aid of a steam pump. Each stroke of the piston drew up twenty-five gallons of water and the pond was emptied in a few hours, and not only was the water drawn off, but all the fishes also were transferred to a new element.

This was a revolution. The owners of ponds in the neighborhood followed suit, and the proprietor of the pump made a specialty of this sort of work. He "let" one of his pumps, modified for the purpose. The peasants of the region called it "the fish pump." Each stroke of the piston brought up torrents of water, in which were fish and crawfish, together with mud and débris.

One pond of several acres was cleared of fish at an expense of 36 francs, or $7.20. The process was ingenious, but as one cannot have his fish and eat it, too, and as such rapid consumption would have led to equally rapid extermination, the local authorities were obliged to take measures to stop the practice.

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"Cravenette" *is a proof, not a cloth*

It is the only proof that will make any cloth *permanently rainproof without the use of rubber.* It permeates every fibre of the yarns of which a cloth is woven, rendering them **thoroughly rain proof.**

This proof prevents a cloth from becoming water-logged, soggy, heavy or wet from rain, snow, fog or dampness of any kind. It is permanent, contains no rubber and does not change the appearance of the cloth in the least.



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Insures foot comfort, health, prevention and good appearance. They keep feet dry, warm in cold weather and dry in cold weather, and can be worn all day long without discomfort or discomfort. EVERYBODY NEEDS EVERSTICKS. Always for sale where good shoes are sold. ACCEPT NO SUBSTITUTES. THE ARCH & FORD CO. Cleveland, Ohio



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Making 34.58 knots Built by Bath Iron Works Limited

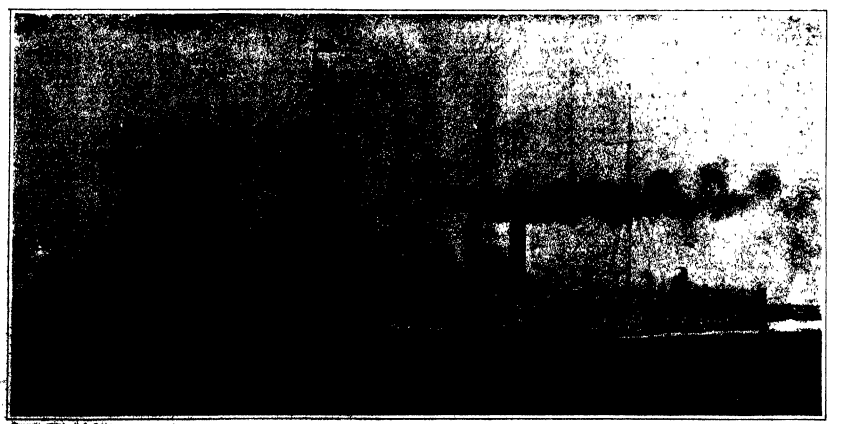
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Builders of Torpedo Boat Destroyers, Torpedo Boats, Fast Steamers and Yachts

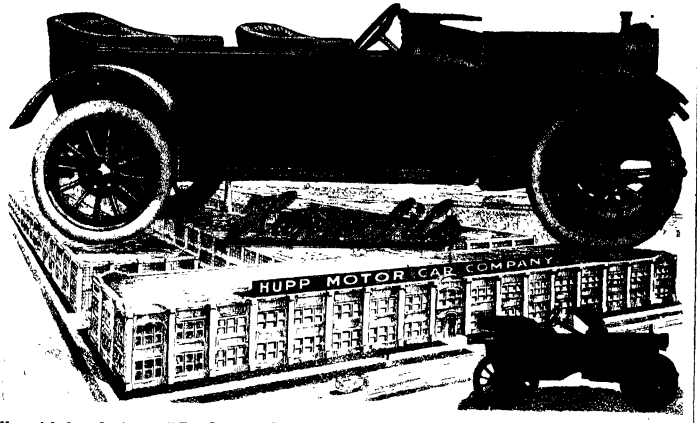
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Length, 420 feet. Beam, 47 feet. Displacement, 4,750 tons. Speed, 26 knots. Maximum coal supply, 1,450 tons. Armor: Deck 1½-inch
Guns: Two 5-inch; six 3-inch. Torpedo tubes, two 21-inch.

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Hupmobile Long-Stroke "32" Five Passenger Touring Car—$900

F O B Detroit, including equipment of windshield, gas lamps and generator, oil lamps, tools and horn Three speeds forward and reverse, sliding gears Four cylinder motor, 3¼ inch bore x 5½-inch stroke Bosch magneto 106-inch wheelbase 30 x 3½ inch tires Color—standard Hupmobile blue

The new touring car will be first exhibited at the Grand Central Palace, New York, Jan 10 17, and subsequently at the principal automobile shows throughout the country

Hupmobile Runabout—$780 f o b Detroit, including top wind shield gas lamps and generator, three oil lamps, tools and horn Four cylinders 20 H P sliding gears Bosch magneto

In the new Hupmobile plant, now nearing completion, which will have when finished a capacity of 15 000 to 20,000 cars a year the Runabout—sleeves a car of unprecedented popularity will continue to occupy the same large part in our manufacturing plans that it does at present.

Hupmobile Coupe—Chassis same as Runabout—$1100 f o b Detroit

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A totally new idea of what you ought to get for $900

A new and larger Hupmobile which immediately thrusts upon your attention a score of *tangible superiorities* which set it in a class apart from cars of its price.

A five-passenger Touring Car for $900 which *rejects every characteristic of commonplace construction;* and makes clear its invasion of the field above that price; by points of difference and departure which no motorist can mistake.

Evolved out of the experience which has built thousands of the Hupmobile Runabout the quality car today, as it always has been, of the runabout class.

Designed by E. A. Nelson, Chief Engineer of the Hupp Motor Car Company since its inception and designer of the original Hupmobile Runabout. To him and the skilled shop organization which he has continuously maintained, we owe the inimitable lines, the marked simplicity, the efficiency and the high quality of workmanship incorporated in the Runabout.

Impressed with the same strong individuality as the Runabout; and still further removed from comparison by:

First, the small-bore, long-stroke motor. Second, the body design and construction which attains the purpose of the "underslung" and avoids all of its disadvantages; and Third, the Americanization, after close study abroad, of invaluable *engineering principles* entirely new to this country.

These highly specialized features speak so plainly of greater structural soundness, more progressive engineering principles; and costlier and more careful shop practice, that it is obvious, they proclaim a product without precedent at the price

Small-bore, long-stroke motor—3¼x5½ inches—60% more pulling power for mountain work and heavy roads, 4 to 50 miles of speed, ability to pick up quickly without feeling the weight of the car, or throttle instantly to a walking gait

Unit power plant

Cylinders cast en bloc, with three bearing crankshaft (found only in other cars selling upward of $2500) instead of two Bearings extra large, having bronze back, Babbit lined.

Valves enclosed by pressed steel cover, keeping oil in and dirt out—noiseless, minimum wear, minimum adjustment.

Thirteen-inch multiple disc clutch, action positive, smooth and easy.

Transmission gears of 40 H P size, run slowly and quietly.

Full floating rear axle, amply strong for a seven passenger car.

Aluminum crank and gear case; drawn steel used in parts where lightness and strength are requisite.

4½ x 8½ Photogravure Free

Write for detailed description and the 4½x8½ photogravure of the new touring car

Hupp Motor Car Co., 1233 Jefferson Ave., Detroit, Mich.

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Advertising in this column is 7½ cents a line. No less than four nor more than 13 lines accepted. Count seven words to the line. All orders must be accompanied by a remittance.

AUTOMOBILES.

A NEW WHITE STEAMER. Model O-O, complete with top. Will sell at a very reasonable price. Address A. A. Hopkins, 963 St. Nicholas Ave., New York City.

AUTOMOBILES AND MOTORCYCLES.

AUTOMOBILES, $50.00 up; Motorcycles, $30.00 up; guaranteed for one year, shipped freight prepaid. Largest list and lowest prices in the world. Ellis, Automobile Broker, Dept. S. A., 215 West 125th Street, New York City.

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A STRONG old established, manufacturing company, with a national selling organization, wants to add a new line of building material or composition specialty to manufacture and sell. Address X. Box 775, New York

FREE SAMPLE goes with the first letter. Something new. Every firm wants it. Orders from $1.00 to $1000. Nice pleasant business. Big demand everywhere. Write for free sample. Metallic Co., Co. 438 N. Clark, Chicago.

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INVENTORS.—Send a copy of your patent to us and we will send you our pamphlet outlining our liberal manufacturing offer. For further particulars address, Atlantic Supply Co., Long Branch, N. J.

HELP WANTED.

LOCAL REPRESENTATIVE WANTED.—Splendid income assured right man to act as our representative after learning our business thoroughly. No former experience unnecessary. All we require is honesty, ability, ambition and willingness to learn a profitable business. No soliciting or traveling. This is an exceptional opportunity for a man in your locality to secure a lifelong business without capital and become independent for life. Write us today for full particulars. Address E. R. Marden, Pres., The National Co-Operative Real Estate Company, L 84 Marden Building, Washington, D. C.

PATENTS FOR SALE.

BASIC PATENT No. 961,057 of a "Inner-Illuminated," two-light interchangeable-ad., Revolving Sign, for sale, outright, royalty or stock rights. It is the most attractive and inexpensive sign invented. No competition, fully developed, and the market demands it. "Inventor," 1008 Broadway New York.

PROPOSALS.

PROPOSALS FOR BRICK DORMITORY, CENTRAL STEAM HEATING AND POWER PLANT Department of the Interior, Office of Indian Affairs, Washington, D. C. November 16, 1911. Sealed proposals, plainly marked on the outside of the sealed envelope: "Proposals for Brick Dormitory, Central Steam Heating and Power Plant, for the Rapid City Indian School, South Dakota," and addressed to the Commissioner of Indian Affairs, Washington, D. C., will be received at the Indian Office until 4 o'clock, p. m., December 26, 1911, for furnishing materials and labor for the erection of a brick dormitory, central steam heating and power plant, at the Rapid City Indian school, South Dakota, in strict accordance with the plans, specifications and instructions to bidders, which may be examined at this Office, the offices of the Supervisor of Construction, Denver, Colorado, the American Contractor, Chicago, Ill. Roth the American New York City, the Improvement Bulletin, Minneapolis Minn., the Journal, Rapid City, South Dakota, the Bee Hive, Mpls., Minn., the United States Indian Warehouses at Chicago, Ill., St. Louis, Mo., and Omaha, Nebr. the Builders And Traders Exchange at St. Paul, Minn. and at the school. For further information apply to the superintendent of the Rapid City Indian School, Rapid City, South Dakota. C F Hauke, Acting Commissioner

REAL ESTATE.

TEXAS INVESTMENTS.—Buy farm orchard garden lands near Houston the greatest and most prosperous city in the southwest, where values are going up all the time and fortunes made in real estate in short while. Easy terms if desired. Single crop pays for land; several crops annually. Address R. C. Robertson, 301 Kiam Bldg., Houston, Tex.

WANTED.

WANTED—Purchaser for Lilley's patent Bracket. Patented in five countries. A very low price will be accepted. For further particulars address, Bracket, Box 775, New York.

WANTED—One chemist at $6.00 per diem, two first-class laboratorians at $5.00 per diem; one second-class laboratorian at $4.00 per diem and two fourth-class laboratorians at $3.00 per diem. Such a competitive examination will be held January 8, 1912, at the Navy Yard, Washington, D. C., for filling the above positions at the Naval Proving Ground, Indian Head Md. For further information address, "Commandant, Navy Yard, Washington, D. C."

MISCELLANEOUS.

RUPTURE. A new patented device worn in place of the ordinary truss. Simple, comfortable, and most positive. Endorsed by leading surgeons. For particulars address J. D. Rowe, M. D., Tiffin, Ohio.

FREE TUITION BY MAIL. Civil Service, Drawing, Engineering, Electric Wiring, Agricultural, Poultry, Normal, Academic, Bookkeeping, Shorthand Courses. Matriculation $5. Tuition free to first applicants. Apply to CARNEGIE COLLEGE, ROGERS, OHIO.

INQUIRY COLUMN

READ THIS COLUMN CAREFULLY.—You will find inquiries for certain classes of articles numbered in consecutive order. If you manufacture such goods write us at once and we will send you the name and address of the party desiring the information. There is no charge for this service, except that it is necessary to give the number of the inquiry. Where manufacturers do not respond promptly the inquiry may be repeated. MUNN & CO., Inc.

Inquiry No. 9040.—Wanted, addresses of owners of locomotives now running not less than 60 inches gage.

Inquiry No. 9041.—Wanted, addresses of owners of locomotive cranes suitable for heavy castings.

Inquiry No. 9042.—Wanted, addresses of makers of bar yarns.

Inquiry No. 9043.—Wanted, address of maker of Spratt's dog biscuits.

Inquiry No. 9044.—Wanted, addresses of manufacturers of radiators, tanques, and driers suitable for making tannic acid.

Inquiry No. 9045.—Wanted, the name and address of manufacturer of lead pencils suitable for use as a stencil for marking on oil.

Inquiry No. 9046.—Wanted, to buy a patent solicitor, a hydraulic ram which would be purchased on a royalty basis. It must be about four inches [illegible]

Inquiry No. 9047.—Wanted, the addresses of persons having [illegible] for the manufacture of [illegible]

Inquiry No. 9048.—Wanted, the address of a firm that manufactures [illegible]

Correspondence

[The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.]

The Diesel Engine and the American Merchant Marine

To the Editor of SCIENTIFIC AMERICAN

In a recent issue comment was made in your columns on the failure of the American inventor to keep pace with his European rival

In the issue of October 7th, a very interesting article appears on the Diesel engine and its economy over the steam engine, especially when applied to ocean-going steamers

One of the remarkable, as well as regrettable conditions, as far as our shipbuilders are concerned, is the indifference displayed to improvements in hull and motive power, particularly motive power, that have appeared in foreign-built tonnage in the past few years

Foreign steamship builders are experimenting with the producer-gas engine, seeking to ascertain its economy as compared with the usual type of three-cylinder engine used generally in steamships, the oil-burning motor marine engine has been given a long test by foreign marine builders, and several steamers to be operated with gas engines are to engage in the trans-Atlantic trade this coming year, and possibly this fall will see one or more gas-driven ocean liners headed for our shores. These steamers that promise to run across this year will be passenger as well as freight

Europe has no oil or fuel, it has to be imported, while the United States is the greatest producer of oil in the world, and yet our shipbuilders lag far and away behind the foreign steamship builder in applying the oil and gas engine to marine service

It is fair to speculate on what causes the paralysis of the American shipbuilder, and one of the apparent causes is that it is shielded too much from competition

The coasting trade—and by the coasting trade is meant every port in the United States and Alaska—from Eastport, Me., on the extreme northeast to farthest Alaska, in the northwest including Porto Rico, is called American coasting trade, and only American built vessels can engage in the trade now, this gives a monopoly to the shipyards of the United States, and shielded from foreign competition the necessity for developing new and improved types of engines and steamers is not found necessary

As to seeking to compete with the foreign builder in the steamship trade of the world, the American gave that up long ago; the only way that he can see, to get even the smallest footing in that trade, is for the government of the United States to pay him for making the attempt

This attitude is the more surprising, as we make iron and steel far cheaper than can any other country in the world, while our exports of iron and steel the past year have been of tremendous volume and the competition of foreign nations in these articles is of no avail against the American manufacturer It is also true that the report to the Stanley committee made by the United States Steel Corporation showed that it sold steel plates $8 to $11 per ton under the domestic prices

That, evidently, is one reason why our shipbuilders cannot compete with the foreign builders; that condition can be remedied by putting steel and iron on the free list, and with these commodities free, Independent yards would be started that would not be so conservative in applying the most modern development in marine engineering to ocean tonnage

The Panama canal will be opened in a couple of years; already one American line is to bid on the contract offered by the Postmaster-General for a line between the American and Pacific ports of the United States, and already it is given out that the steamers this line will require to carry out the contract if secured will tax the capacity of our coast yards, when combined with the government work. Further government contracts must be considered only on a different basis.

[illegible] that, in a few years, will show all a tremendous rate. Alaska has mineral stores that will keep a mighty fleet busy, to say nothing of the trade between Honolulu, Philippines and the United States It is true that the Philippine carrying trade is not yet confined to American built steamers, and it is lucky it isn't, for there is no American tonnage to-day that would engage in it except at prohibitive freight rates

If ever there was a time propitious for the restoration of the American flag to the deep sea trade, it is now. The new development in marine engineering will make the vast foreign tonnage built up to the present time practically obsolete. As stated in your issue of October 7th the economy of the Diesel engine is so great, that no coal-burning steamer can compete with the motor-driven And yet we have still to learn of any interest being taken in this new marine departure by any American shipbuilder It was the same with the turbine engines We followed far behind Europe, even in the experimental state

We were far behind Europe in taking up the automobile and the airship It is true that we came to the front with a rush, and we may do so in shipbuilding eventually What our iron and steel industries need is, less coddling by the government, the stimulus of competition will enable us to achieve a place in the deep-sea carrying trade of the world that subsidies will never secure for us

And again it becomes apparent that the tonic of free ships would be of immense benefit to our deep-sea foreign trade A free ship bill now would allow our people to invest in these modern motor-driven ocean steamers and establish the American flag in the carrying trade of the world, and the old bugaboo of the American wage scale would be of little consequence in this type of steamers as the coal heavers would be a thing of the past

Chicago, Ill CHARLES DEPEREE

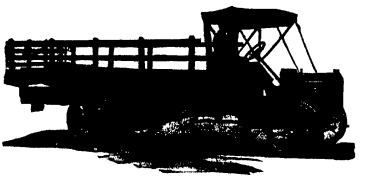
Nitrogen and the Soil

To the Editor of SCIENTIFIC AMERICAN:

I am in receipt of a copy of the letter of Drs Lyon and Bizzell of Cornell University

Their contention that they were the first to announce the fact that non-legumes may secure a part of their combined nitrogen from legumes (when the two are growing together) should be qualified According to their own admission, their first article was received by the editor of the *Journal of Industrial and Engineering Chemistry* on April 21st, 1910, and appeared in July, 1910 The inclosed letter from Prof A D Hall, Director of the Rothamsted Experiment Station, and editor of the *Journal of Agricultural Science*, will show you that my article was received by him in August or early September of 1909 Unfortunately, however, the issue of the number of the *Journal of Agricultural Science* containing my article, was delayed for more than a year, and the article in question appeared in print, therefore, in 1910, instead of 1909 In this article of mine, I state distinctly that the non-legumes, separated by a porous wall from the legumes, were able to obtain very considerable quantities of combined nitrogen Furthermore, the photographs show distinctly the benefit derived from the association I did not submit analyses, even though those had been made, since I did not regard it necessary to submit figures in a preliminary publication Furthermore, the bulletin published by Drs Lyon and Bizzell, and entitled "A Heretofore Unnoted Benefit from the Growth of Legumes" is dated March, 1911. In other words, this was submitted to the printer several months after my article in the *Journal of Agricultural Science* appeared in print According to the admission of Drs. Lyon and Bizzell, the number of the *Journal* containing this article was received at the Cornell University Library in October, 1910. Hence, they were not justified in designating their bulletin as they did by the title given above.

It will be shown by the writer (in his



What Motor Trucks Mean

IF you are not using motor trucks, we take it for granted that you do not understand the benefits to be derived from them. Possibly you have the wrong viewpoint—perhaps you have been making too many comparisons with the horses and not really investigating what the truck meant to you as a machine to perform certain work. The individual or firm that has a better delivery system has an advantage—the kind of business doesn't matter—service is appreciated universally. If The White Company can place in your hands a more efficient means of making deliveries, they have given you an opportunity of extending your field—of broadening the horizon of your product—of making good—where you had been unable to go before.

White Trucks Known for Performance

GO into any large city in the United States—ask the men who have the largest delivery problems, to see what they know about these White trucks. Almost regardless of whether they own them or not, you will find that they know their record for splendid performance. To the man about to invest in trucks, a list of White owners will appeal as almost a directory of the big business men. They have invested their good money in White trucks and their endorsement is the fact that they are continually increasing their equipment. No one buys and buys again the thing that fails to stand the test. We could tell you why—because it is all in the designing—in the building—in the care we take in the production of the truck. The important thing to you is that they do perform—that White trucks satisfy their owners—and, therefore, must be the kind that you want.

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Let us submit a solution of your delivery problem. It will entail no obligation

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We offer to all poultry raisers the essential knowledge and secret methods of many of the most successful poultrymen of America. As a rule these secrets have been guarded with extreme care, for it is on them that the great successes have been built. They have cost years of labor and thousands of dollars. They will cost YOU only a trifle and a few minutes to write us.

How We Obtained These Secrets

Michael K. Boyer, Associate Editor American Poultry Advocate, has had exceptional opportunities and the closest friendship with poultrymen all over the country. They have freely told him many of their most jealously treasured secrets, many others we have bought, and this scattered material, together with several of Mr. Boyer's own valued methods, has now been collected in book form. It must be clearly understood that **every secret printed has been obtained in an honorable way.**

"Poultry Secrets"

First published in 1908, this collection of the carefully guarded secrets of famous poultrymen created a sensation in poultry circles. It has run through thirteen editions, and is still selling at a lively rate

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Is this cock properly held? "Poultry Secrets" tells you how to carry fowls, and scores of secrets far more important and hitherto unrevealed

READ WHAT PURCHASERS SAY

I received Farm Journal and "Poultry Secrets," and am very much pleased with both. The secrets are worth their weight in gold. Why, I paid $5.00 for the sprouted oat method. You certainly give a fellow over his money's worth. Andrew F. C. Morey, Utica, N. Y.

I purchased a copy of "Poultry Secrets," and find many helpful ideas in it, especially Dr. Wood's Egg Hatching Secret.
Mrs. F. T. Darnell, Westfield, Ind.

By putting within our reach these "Poultry Secrets," you are doing a more philanthropic work than giving alms or endowing hospitals, for you make it possible for us to make both ends meet.
L. Boyce,
Milwaukee, Wis.

Received your book of "Poultry Secrets." It's an exceptionally instructive work, and worth $10 to any progressive poultryman. I would not care to take that for my copy if I could not get another.
Robt. F. Kingsland,
Montville, N. J.

The Farm Journal came to hand, and later "Poultry Secrets," also arrived, all of which I was very glad to receive and have been greatly interested in reading same, and think you are doing a glorious work in diffusing such valuable knowledge for so little money.
F. B. Meade,
Boston, Mass.

As to "Poultry Secrets," I will say I have lectured on the subject over the greater portion of the state for the past fifteen years and have about every book that is published on this subject in my library, and I consider the book of yours the most valuable I know, by far, for the general public.
L. A. Richardson,
Maine, Ill.

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Revised and up-to-date

Profusely illustrated, with many fine drawings and diagrams. 64 pages
Have you use for such a book? Then read the Offer below.

The **POULTRY SECRETS BOOK** is sold in combination with the Farm Journal, Philadelphia. The **FARM JOURNAL** is the standard paper for every one who lives in or near the country, or ever has, or ever expects to. A partial list of its poultry department, more valuable than most poultry papers: 33 years old, 750,000 subscribers and more. Goes everywhere. Clean, clever, cheerful, amusing, intensely practical. Cut to fit everybody, young or old, village, suburbs, or rural routes. Unlike any other paper and always has been.

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SPECIAL OFFER For $1.00 (cash, money order or check) we will send prepaid the **Poultry Secrets Book** and the **Farm Journal** for two years and **American Poultry Advocate** two years, all for $1.00 (in Canada $1.00, foreign countries $2.00) if order is sent at once to

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forthcoming bulletin) that the beneficial effect of legumes or non-legumes, was noted and recorded many years ago; in fact, empirical observations on this subject were recorded more than one hundred years ago in English books on agriculture. Hence, the writer does not claim that he was the first to observe this effect. Nor are Lyon and Bizzell justified in making this claim for themselves. It is the contention of the writer that he was the first to demonstrate in an exact and scientific way (by properly controlled pot experiments) that diffusion of nitrogen compounds, out of the roots of legumes takes place, and that these nitrogen compounds may diffuse through sandy soil and through porous earthenware, and may be absorbed by non-legumes separated from the legumes in this manner.
JACOB G. LIPMAN, Director.
New Jersey Agricultural College Experiment Station, New Brunswick, N. J.

Wooden Shoes

To the Editor of SCIENTIFIC AMERICAN.

In your issue of October 28th, 1911, under the caption of "Wooden Shoes," the United States Vice-Consul at Amsterdam, Holland, is made to say that Lancaster County, Nebraska, is a large importer of wooden shoes from Holland. For the benefit of your readers, and particularly the enlightenment of the Honorable Vice-Consul, we would like to have it understood that Nebraska is thoroughly civilized and we have the lowest percentage of illiterates of any State in the Union. The United States Custom House was opened in Lincoln twenty years ago, and a search of the records of importations fails to disclose a single shipment of wooden shoes for any firm in the State.

You might be interested in knowing that the largest wooden (shoe) sole factory in this country is located at Columbus, Nebraska, sixty miles north of Lincoln, and that the entire output is consumed in the territory lying east of Ohio and north of the Potomac River.
W. S. WHITTEN,
Secretary Lincoln Commercial Club.
Lincoln, Neb.

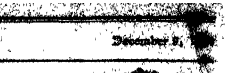
Lieut. Rambaldo—The End of a Promising Career

SOME months ago the SCIENTIFIC AMERICAN mentioned the daring project, conceived by Lieut. A. E. Rambaldo, of the Dutch navy, of exploring the interior of New Guinea by drifting over it in a balloon. This plan found many warm supporters in Germany, where it was chiefly promoted, but had at length to be given up, as the necessary funds were not forthcoming.

Recently news has been received that Rambaldo met an untimely death in Java on August 5th, while making a balloon voyage, in company with Lieut. van Steyn, also of the Dutch navy, from Soerabaia in the direction of Semarang. In attempting to make a landing in a forest, Rambaldo had climbed into the upper branches of a tree; a sudden upward movement of the balloon pitched him to the ground, while his companion was carried away in the lightened balloon. His lifeless body was recovered the following day. Van Steyn effected a safe landing.

Rambaldo, who was not yet thirty-two years old at the time of his death, was an aeronaut of the type that is common in Germany than elsewhere. He was a keen student of the new science of aerology, and spent many months in studying the methods of upper-air research at Lindenberg Observatory and at other aerological stations. Subsequently he made a long and valuable series of kite observations during a cruise to the West and East Indies on board the Dutch man-of-war "De Ruyter." Having been ordered to duty in Java, he founded an aeronautical society in that colony, and took an active part in inaugurating the aerological work of the Batavia Observatory, the brilliant results of which during the last few months have added much to our knowledge of the upper atmosphere.

At the time of his death he was planning to return to Europe to take a course in aviation, and had recently published in the German aeronautical press the outline of a project for introducing this art on an extensive scale in Java, for scientific and practical purposes.



The Dean removing scale from the tube of a return tubular boiler.

SCALE

plays havoc with a boiler and digs deep into the coal pile.

And you can't prevent scale from forming by the use of chemicals.

You must remove it by a mechanical cleaner.

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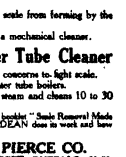
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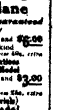
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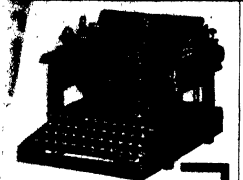
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(12572) S B. asks: If a meter were attached to the wire of a five-horse motor, and the current (500 volts) turned on for, say, one hour, running only single motor, would it use as much juice in one hour as if the motor were doing full five horses' work? A. If a five horse-power electric motor is run without load, it will only require the current to turn it which is able to overcome the friction of the parts of the motor. If full load is put upon the motor, it will then require five horse-power to turn it. This is exactly the same as any other machine, a grindstone, for instance. A boy can turn it swiftly when there is nothing grinding upon it, but if a man holds a scythe upon it, bearing down with all his force, even a man might not be able to keep the stone in motion. Power must be furnished to any machine in proportion to the work called for from the machine.

(12573) G W M asks: 1. What are the chemical elements found in the atmosphere? Is there any chemical change when subjected to heat? A. Atmospheric air is made up of 21 per cent of oxygen, 78 per cent of nitrogen, about 1 per cent of argon and a minute trace of helium, xenon, neon, krypton hydrogen. No chemical change is produced by simply heating the air to any moderate degree unless some other substance is present which can be burned with the oxygen. At the temperature of the electric arc the nitrogen and oxygen combine and form nitric and nitrous oxides. 2. How is commercial oxygen used in medical science, produced? A. Oxygen for industrial and medical purposes is made from chlorate of potash or from binoxide of sodium. The former is heated in a retort with manganese dioxide, and the latter is simply dropped into water.

(12574) E J L asks: Will it be too much bother to advise me the number of cubic feet in a perch of stone? The dictionary and printed authorities all seem to agree on 24¾, but masons here claim that there are only 16½. A. A "perch" of masonry is not a measure whose value is everywhere the same. It seems to be usually 16½ feet long and 1½ by 1 foot which would make it contain 24¾ cubic feet. It is often taken at 25 cubic feet. It has other values in different parts. If such peculiar measures could be dropped and our work measured in feet, yards, etc., it would greatly simplify matters.

(12575) J B C asks how to oxidize silver. A. 1. Add four or five thousandths ammonium sulphide or potassium sulphide to water at a temperature of 160 to 180 degrees Fahrenheit. When the articles are dipped into this solution an iridescent coating of silver sulphide is produced which, after a few seconds, turns blue black if allowed to remain in the bath. Remove, rinse, scratch brush and burnish when desired. 2. There are two distinct shades in use, one produced by a chloride which has a brownish tint, and the other by sulphur, which has a bluish-black tint. To produce the former it is only necessary to wash the article with a solution of sal ammoniac (ammonium chloride). 3. A much more beautiful tint may be obtained by employing a solution composed of equal parts of copper sulphate and ammonium chloride in vinegar (or dilute acetic acid). The fine black tint may be produced by a slightly warm solution of sodium or potassium sulphide. 4. Bromine, 5 gr.; potassium bromide, 5 dwt.; water, 10 oz.; boil the silver in this usually 2 to 5 minutes, then polish with rouge. 5. Dissolve sulphate of copper, 2 dwt.; nitrate of potash, 1 dwt.; ammonium chloride, 2 dwt.; in a little acetic acid. Warm the article and apply the solution with a camel's hair pencil and expose to the fumes of sulphur in a closed box. Parts not to be colored must be coated with wax. 6. Dip the clean silver article in a solution of sulphide of potassium (liver of sulphur), 2 dr. to 1 pt. of water. Heat this solution to a temperature of 170 degrees Fahrenheit. Immerse for a few seconds only, when the article becomes blue black. For a velvet black, dip the article, previous to oxidizing, in a solution of mercurous nitrate and water, and rinse. Then dip in the sulphide solution as above. For a brown shade, oxidize the potassium sulphide as above, then dip in a liquid composed of 10 parts of blue vitriol and 5 parts of sal ammoniac to 100 parts of vinegar. After oxidation, brush with a scratch brush very lightly, to brighten and variegate the surface. There are many other methods, among which will be found the following: 7. Expose to the vapor of chlorine. 8. Use a solution of equal parts of copper sulphate and ammonium chloride dissolved in vinegar.

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THE CORSICAN A Diary of Napoleon's Life in His Own Words By R M Johnston Boston and New York Houghton, Mifflin & Co 526 pp Price, $1 75

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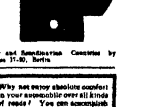
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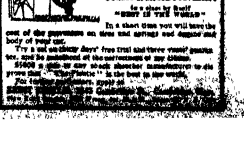
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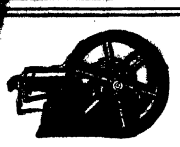
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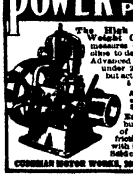
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To reach its highest efficiency a manufacturing plant must be watched as a doctor watches a patient It is the cost-keeping department that must point out the weak spots and indicate a remedy Without accurate knowledge of weak spots—that is, of instances where the cost of operations exceeds or approximates the selling price—remedies are mere guess work On the other hand, there is so much of complication and red tape about many cost-keeping systems that manufacturers hesitate to adopt them Mr Bunnell while avoiding in great measure the encumbrances incident to these systems, sacrifices nothing of efficiency He answers the debt of cost-acquisition in a general way, gives some valuable counsel on the introduction of an adequate system, and then proceeds to sustain and amplify the general principles by reducing them to practical application All the necessary accounting forms are drawn and their uses explained so that the routine of cost keeping may be established with the least amount of labor and worry, and may result in accurate and progressive knowledge of vital facts and details He clearly demonstrates that the efficiency of this department and the prosperity of a business are very closely related It would be hard to find a more enlightening or sensibly-written work on the subject

MOEDEBECK'S TASCHENBUCH FUR FLUG TECHNIKER UND LUFTSCHIFFER Berlin Verlag von M Krayn, 1911 920 p, 238 illustrations

It was in 1905 that the late Capt. Moedebeck issued his admirable aeronautic handbook When we consider that the dirigible at that time had hardly developed much beyond the experiments of Renard, and that Lilienthal alone had made any experiments in dynamic flight, we can readily understand how bold an undertaking Moedebeck's was Yet he carried through his scheme with good judgment and with such foresight that his book proved a boon when the dirigible really took its place in our daily lives In the first edition it was almost out of the question to devote much space to the flying machine for the simple reason that the flying machine as we know it did not exist In the second edition, issued in 1903, the remarkable performances of the dirigible still took up the major portion of the book Unfortunately Capt Moedebeck was not spared to revise this last edition that task has been intrusted to Prof Suering, of the Royal Meteorological Observatory at Potsdam That he has done it ably follows almost as a matter of course from his scientific standing As it now comes to us, the book is divided into the following chapters Gas (The Physical Properties of Gases and Technology of Gases); Atmospheric Physics, Aerological Observations, Kites and Parachutes, Balloon Technics, Navigating a Balloon, The Basis of Balloon Navigation, Practical Aspects of Balloon Navigation; The History of the Airship, Airship Construction Practical and Experimental, Navigation of Air Vehicles, Animal Flight, Gliding Flight, Technics of Flying; Engines for Airships and Flying Machines; Aerial Propellers, Society News, Tables

ARTISTIC HOMES. By Mabel Tuke Priestman. New York: A. C. McClurg & Co., 1911 8vo; 148 pp; illustrated Price, $2 net.

There is a steadily increasing appreciation of sensibly-planned and at the same time artistically satisfying houses that is encouraging to those of us who would have America surpass her older rivals in modes of taste as well as in business methods A home that is pleasing and restful to the eye contributes substantially to the contentment and education of mankind, and costs no more in the long run than many of the pinnacled and castellated atrocities we see around us. The growth of this appreciation of the truly beautiful and useful in home-making has been fostered to no small degree by such works as Mrs. Priest's "Artistic Homes," in which are described and pictured ideal dwellings visited by her in this country and in England, with concise statements of their cost and all the essential details of their construction.

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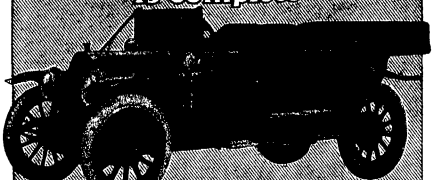
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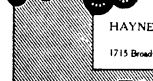
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Huge Icebergs of the Southern Ocean

THE September *Monthly Meteorological Chart of the Indian Ocean*, published by the British Meteorological Office, contains a most useful account of the icebergs of the Southern Ocean, as reported by ships of all nationalities during the twenty years 1891-1910

In the southern hemisphere icebergs attain dimensions far exceeding that attained by similar formations in the northern hemisphere They may be fallen in with anywhere poleward of the parallel 30 deg S As many as 4,600 different bergs have been actually counted in a run of 2,000 miles; estimated heights of from 800 to 1,700 feet are not uncommon; and instances of bergs having lengths ranging from 6 to 82 miles are numerous

The most northern ice of the Southern Ocean, so far as the records from the beginning of the nineteenth century show, was a fragment of a berg sighted by the barque "Dochra" in 28 deg S., 26 deg W., in April, 1894 Icebergs are seldom sighted on the regular trade routes south of Australia, between the west coast of South America and the meridian of 80 deg W, and between the Falkland Islands and the east coast of South America

As to the abundance of icebergs in certain years, besides the case above mentioned of 4,500 bergs seen in one voyage, several other remarkable records are cited Thus in March, 1910, the "Prima" passed between 2,000 and 3,000 icebergs in two days, while steaming from 54 deg S 36 deg W to 47 deg S 38 deg W

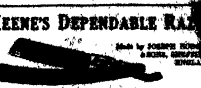
The many flotillas of icebergs passed by vessels during the prolific period 1892 to 1897 included some of the loftiest on record In January, 1893, when 400 miles east of the Falklands the "Loch Torridon" passed many bergs varying in estimated height from 500 to 1,000 feet, and one of 1,500 feet The "Charles Racine" sighted a berg 1,500 feet high, midway of the Cape and Australia, in December, 1896, and one of the same height was sighted from the "Zinita, In November, 1904, about 120 miles south of the spot where that of the "Loch Torridon" was observed The loftiest berg on record, which had an estimated height of 1,700 feet above sea level, was passed by the bark "Emil Julius" in June, 1884, when in 44 deg S 49 deg E Since the beginning of 1889 there have been reported 39 instances of bergs from 800 to 1,700 feet in height, and 16 of these had an altitude of 1,000 feet So far back as 1840 a berg 1,000 feet high was sighted not far from the Cape of Good Hope

Since the beginning of 1884, 42 ships have reported bergs having estimated lengths of from 6 to 82 miles In May 1892, the "Strathdon," in 44 deg S 30 deg W., sailed 40 miles along the side of a berg This ice-island was 1,000 feet high In January, 1893, the "Loch Torridon," in 50 deg S 45 deg W., by sailing along the side of a berg determined its length to be 50 miles, and two months later, about 200 miles farther west, the bark "Æthelbert" is said to have passed one which was 82 miles long! Some of the extreme lengths reported in good faith are however, perhaps based on optical illusion; as a berg is sometimes unwittingly viewed through a gap between two other huge bergs, situated on either side of it, and overlapping its ends A case of this kind was observed during the "Challenger" expedition

A cubical iceberg will float with about one-ninth of its total height above the water It is not difficult, however, to imagine a lofty pinnacle berg having its base spread over a large area, and the under water depth comparatively insignificant In the majority of bergs the vertical heights of the submerged and visible portions seldom vary directly as the corresponding volumes.

Throughout the five months ended April, 1855, a book-shaped ice-island drifted about between the parallels of 40 deg. S and 44 deg S and the meridians of 20 deg W. and 28 deg. W The longer side stretched 60 miles, and the shorter parallel side 40 miles Between the two was a bay quite 40 miles from side to side at its widest part. Several ships entered this *cul-de-sac* under the erroneous supposition that there was an exit; and one was lost with passengers and crew. In 1892 and 1893 the "Urmodia," [illegible]

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SCIENTIFIC AMERICAN

Annual Motor Number



Annual Motor Number

JANUARY MAGAZINE NUMBER
of the SCIENTIFIC AMERICAN
Issue of JANUARY 6th, 1912

In what respect do leading types of motor trucks for 1912 differ mechanically? How can the owner best protect his investment in motor trucks? What is the cost of operation as compared with horse-drawn trucks? Can truck chauffeurs be made of ordinary teamsters? These are vital questions to the intending purchaser of motor trucks, which are ably discussed in an article entitled **"Selection of a Motor Truck."**

The pleasure vehicle has now become so standardized that the **Riding Qualities of an Automobile** (the subject of an another article) now receive more thought than heretofore. The springs, the upholstering, the balance and hang of the body, all enter into the making up of a comfortable car. Other matters now of paramount importance to the motorist are the **Abolition of the Starting Crank, Lighting Systems,** which make automobiling at night safe and pleasurable, and the efforts to solve the **Tire Problem.** These form the subject of three special articles.

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dale," and "Ranee" had a like experience At daybreak one morning the "Wasdale," northeast of the Falkland Islands, was discovered to be in a bay, of horseshoe shape, hollowed out of the side of an ice-island This bay was 20 miles long It varied in width from 10 miles at its broadest part to 4 miles at the entrance, and swarmed with large loose bergs

Recent Views on Road-Tarring

By Dr. Guglielminetti

SINCE the author made the first tests as to the tarring of macadamized and other roads about ten years ago, the question has been taken up in France by the Dust Prevention League, and the results were discussed at the International Congress of Roads held at Paris in 1908 and at the Brussels Congress of 1910 Since that time, it may be said that surface tarring has entered into standard practice As regards the question of hygiene, it appears that the desired end has already been reached, inasmuch as the amount of dust is much lessened The other point to be considered is that of cost All road engineers are agreed that tarring has the effect of lessening the wear of roads and increasing the life of the pavement, to say nothing of the reduction in street-cleaning expenses, including watering, mud removal and sweeping

But it was somewhat difficult up to the present to give any good figures for the economy realized on any given road In fact, it requires a certain time to estimate the economic results as to upkeep of a road where the nature and amount of traffic vary considerably from one year to another At present we are able to give some figures relating to the Avenue du Bois de Boulogne, a wide avenue leading out to the large park of the same name The figures are given by M Bret one of the city engineers This avenue is one of the finest in Europe, measuring 0.93 mile in length and 53 feet in width, and being bordered by a riding track and a footway The total surface is 25,466 square yards It was newly macadamized in September, 1906, and was first tarred in May, 1907 Since then it has not been macadamized, before the tarring was adopted it had to be relaid every three years The figures for expenses were drawn up for three and one half years preceding the tarring, then for four years afterwards Comparison of the figures shows that the annual saving up to the present is 11 cents per square yard, or about 25 per cent on the relaying and upkeep expenses alone not counting the economy on cleaning expenses It is noticed that the road was tarred only once in 1907, and after 1908 it was tarred twice a year, in spring and autumn The author, who is a leading official of the league, arranged with the city engineers so as to have tarring done in autumn in order to have a fresh surface for the winter traffic The result was striking, and in the spring following it was found that the surface was still in a very good state and the tar had remained on the greater part of the road surface, except in the middle where it had commenced to wear off

The economic question involved appears to be settled, and the life of the road may be considered as doubled, so that the tarring expenses are more than made up by the increased wear, as above shown On the other hand, the frequent relaying of ordinary roads, which requires two months, causes great disturbance in the traffic, while the tarring process needs but a few days in order to allow the tar to dry

As regards the efficiency of the process in laying dust, the results are remarkable Before this, the avenue in question had to be frequently sprinkled in the hot season every two or three hours, but one washing per day is all that is now required, and no one complains of the dust Many thousands of automobiles per day pass over the avenue, so that at certain times, it used to be almost impossible to carry out the sprinkling, hence arose great clouds of dust and much discomfort and spoiling of clothes At present this has disappeared, and all agree as to the benefits of the tarring process

It would be too much to say that tarring could be carried out with equal advantage on all kinds of macadamized roads; for in the present case the traffic,


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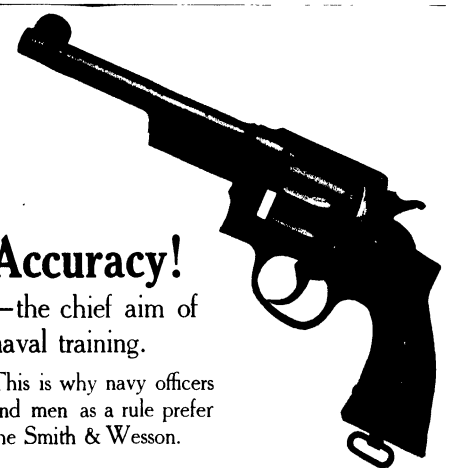
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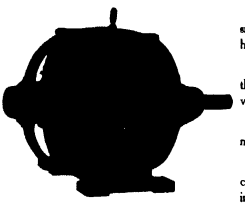
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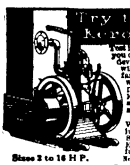
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though dense, consists exclusively of light private vehicles, as the road is closed to heavy conveyances. In considering the question we must see what roads are best adapted to the tarring process. The failure properly to take into account this factor may explain the want of harmony between the city engineers having charge of streets and the engineers occupied with country roads, which was noticed at the Brussels Congress. The city engineers favored the suppression of macadamized roads in cities and considered that such should be paved with stone, wood, or asphalt as traffic increases. Opposed to this opinion were the other road engineers of nearly all the nations represented, and they showed the good results which road tarring had given, claiming that in towns having a lighter traffic this could be used to advantage. To conclude, a judicious choice should be made, and the tarring should not be done on macadamized roads where the heavy traffic required a re-laying every two years or even once a year. Such roads should certainly be paved, reserving the tarring for other kinds of ways.

The question, however, has been raised as to whether tarred roads have not a bad effect on the eyes of drivers and also upon trees and plants which border the routes. As to the harm done to the eyes, proof appears to be wanting, as the road from Paris to Versailles is entirely tarred, as well as the above-mentioned avenue, and we hear of no serious complaints for eight or nine years past, nor upon the roads in the south of France around Nice, where the dust is much greater. Laboratory experiments as to the effect of such dust on animals' eyes are of no avail, as any kind of dust is of course bad for the eyes.

Opinions are divided as to trees and flowers. Plant-growers claim that dust and tar vapors cause harm, while engineers think this is exaggerated. At Paris, the opinion is in favor of the tarring, in spite of any slight harm that may be done, owing to its other advantages. Dr. Griffon, in a paper read before the Academy, speaks first of tar vapors and then of dust. Vapor is bad for plant cells in laboratory tests, but this is not conclusive, as in reality such vapor must be very weak. He noticed that after the spreading and during the hardening of the yet unused roads, no effect was seen on the plants. As to dust, this has some effect on weak plants such as the begonia and others, which is not given from ordinary roads, but trees and shrubbery, also most plants and flowers, appear to show no harm. Leaves of trees may become brown or withered, but this often occurs in city streets, and is due to other causes. On the whole, his extensive inquiries in France and England lead him to favor the tarring.

No complaint apears to be heard in other countries. Since 1910, over 10,000 miles of road has been tarred in England, and the review *The Surveyor* does not note any serious injury to the eyes nor to plants. In Germany the same opinion appears to prevail, as also in Belgium. Owners of villas and gardens in the Riviera are among the most prominent members of the league, showing that they still favor the tarring. One reason for this latter opinion is that the plants in the south are of stronger growth, which leads to the opinion that the plants on Paris avenues should be changed. To bring out the question, the Prefect of the Seine department lately appointed a commission of leading experts. Shrubbery and various plants will be set out along tarred and untarred routes to compare results, and laboratory tests will be made upon any spots occurring in leaves. Attempts are made to purify tar and some samples are now produced which are much less harmful to plants and come near to Norway tar, which is quite inoffensive. It remains to be seen whether this will be economical or not. In any case, it seems evident that it is better to change the plants than to abandon the tarring, owing to its disadvantages. Dust also needs to be suppressed as much as possible. Even while no dust comes from the wear of the road itself, such is brought from the outside by wind or vehicles. The road should therefore be properly watered, and the author proposes to use one of the recent oil products which mix with the water, such as

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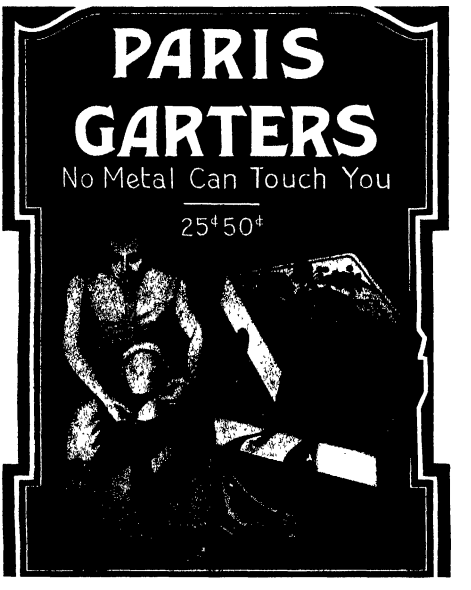
"Westrumite," and this will aid in keeping down the dust.

The Crusade Against the House Fly

ON July 24th, there was instituted in Washington, a most interesting crusade against the common house fly For several seasons one of the leading daily newspapers of the capital has been printing in display type the legend SWAT THE FLY, but this summer this same paper began its campaign in earnest Realizing that it is human nature to desire a pecuniary incentive for any public service, several hundred dollars in prizes were offered, one hundred dollars being the grand prize for the greatest number of flies killed, and many other prizes of lesser amounts representing first, second, third and fourth prizes, etc Only children under the age of sixteen were permitted to enter the fly-swatting contest Each contestant is furnished with a fly swatter, and paper boxes for the dead flies were distributed Each day the boxes containing the offerings of the workers are collected and the flies so exterminated are first counted at the Health Office, and then cremated The first five days of the campaign saw the leader in the contest with the proud record of 40,000 flies killed, with a long list of those who had more than 20,000 to their credit It is interesting to note that the children have organized themselves into squads and range over several blocks of territory, killing the flies in kitchens, grocery stores, stables and refuse heaps Even out of doors the fly has no peace but is kept busy dodging this veritable army of determined swatters Up to date, by actual count more than 2,000,000 of these pests have been exterminated, and the service performed in the interest of public health is enormous, when compared to the comparatively small outlay of money The only pity of it is that the campaign had to be financed entirely by private means, and that the municipality of the District of Columbia could not "raise the ante" and make the prizes attractive to grown persons as well It is not expected that in four weeks of the *Evening Star's* contest, Washington will be reduced to a state of absolute flyless ness, but that there will be a slump in next season's crop there is not the slightest shadow of doubt Considering the propagating possibilities of the fly, it would seem worth while for other cities to follow Washington's example in this regard and get the children started Think of the enormous slaughter of flies there would be on the East Side, for instance, if the myriads of kids, excited by the prospect of winning a handful of dollars, could be induced to "swat the fly."

Restoring Hardened Rubber.—Everyone is familiar with the very undesirable change to which rubber is subject on prolonged standing, such articles as rubber tires becoming hardened and brittle According to a note published in the *Motor World*, there is a simple remedy for this trouble, provided it has not gone too far This consists in immersing the article for a short time in an alkaline solution composed of one part of ammonia to two of water As an example of the efficiency of this process, an old bicycle tube which seemed beyond restoration was found quite fit for use after half an hour's immersion in such a solution, In explanation of the effect it is supposed that there is a tendency for acids to be formed in the rubber, and that these acids are neutralized by the alkaline solution On the strength of this, it is suggested that when tubes or other rubber articles are stored, a small quantity of quick lime or ammonium carbonate be included in the wrapping, though it could be kept from actual contact with the rubber. Periodic washing with ammonia and water is also suggested as a preventive.

Boston Street Lighting.—The total number of lamps on Boston's streets on January 10th of this year comprised 3,973 arc lamps, 1,206 tungsten incandescent, and 11,742 gas. During the year 1910 the cost of electric lighting was $408,900, that of gas lighting, $277,356. Naphtha lights were used in small numbers during the year at a cost of $1,832, but all of these have now been replaced with gas lights.—*Municipal Journal.*



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NOVEL TRANSPORTER BRIDGE OVER THE RIVER TEES.—[See page 556.]

SCIENTIFIC AMERICAN

Founded 1845

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The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *exceptionally* good, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

The purpose of this journal is to record accurately, simply, and interestingly, the world's progress in scientific knowledge and industrial achievement.

"Made in Germany"

TIME and time again the statement is made that Germany is the most scientific country in the world, scientific not simply in the sense that she has produced some of the most eminent chemists, physicists, biologists and physicians of modern times, but scientific in the fact that she has developed a system of commercially utilizing the immense amount of learning stored up in professorial brains. We in America have the reputation of being the most practical people in the world, of converting into dollars, by the most ingenious machinery ever devised, the unsurpassed natural resources of a continent. Yet if we compare the manner in which we have obtained the commercial respect of Europe, with the manner in which Germany has wrested from England a part of that export trade upon which the very life of England depends, we must concede that we have become prosperous largely through the bounty of Nature. With coal mines that must be worked at depths that tax all the resources of modern engineering, with forests that cannot compare even with the remnants of those that have been left to us by rapacious lumber companies with ore beds so limited in extent that iron must be imported in huge quantities from other countries, Germany has succeeded, in the short space of forty years, in becoming one of the most powerful industrial nations in the world.

And this she has accomplished not in an accidental, hap-hazard way, but consciously and systematically. The work that her generals accomplished in France in 1871 has been supplemented by the scientific generals of peace, by statesmen, university professors, doctors and chemists, who planned a policy of commercial development that would answer not simply the needs of to-day, but the needs of a generation to come. In 1876, the late Prof. Reuleaux came to this country as a German commissioner to the Philadelphia Exposition—one of the first opportunities seized by the newly formed empire to show its industrial strength. Reuleaux cast one despairing glance over the German exhibits, and promptly cabled to Bismarck "Our goods are cheap but wretched." That cablegram worked an industrial revolution. "Made in Germany" now means something more than mere cheapness.

How much real science is embodied in that catch phrase "Made in Germany," we intend to show in a series of articles which will appear in early issues of the SCIENTIFIC AMERICAN. To gather the information necessary for a series of articles so broad in scope, we sent our managing editor abroad to make a first-hand study of German commercial life and the part that science plays in governing cities and conducting a business.

Germany and German commerce are favorite topics of discussion these days, but there are phases of German commercial activity which, as we are to see, are only too little known to Americans. The Government's own relation to science, for example, as it is embodied in the work done by the Koenigliech Material-Pruefungsamt, near Berlin, is probably not fully appreciated in this country. Where, for example, would it be possible for a manufacturer of coats or of shoes to have his products scientifically analyzed by an impartial board of experts for a small sum of money and critically compared with the similar products of foreign and domestic manufacturers, all for the purpose that he may profit by the comparison, and with him German industry at large? Where, in all the world, is there a counterpart to the remarkable technologic museum at Munich, a public institution where a man may study chemistry, engineering, optics, physics, weaving, printing, with the aid of apparatus that he himself can set in motion? Where in America will we find the art of governing a city reduced to such a science, that it becomes possible for a municipality to operate its own railways, its own electric light plant, its own gas and water works, and to rent land, all with a profit? Where will we find a workman so scientifically cared for that his health, his hours of labor, his housing, his old age, are made subjects of the most paternal governmental concern? Where in America, with the isolated exception of the Chicago stockyards, will we find the by-products of an industry so completely utilized in building up vast industries that it is difficult sometimes to find a by-product to be converted into a useful article of manufacture?

We are not blind to the fact that, thanks to our youth and courage, Americans have created industries that overshadow in vastness anything that the old world has to offer; nor to the fact that it would be difficult, if not impossible, for a republic necessarily sensitive to every popular whim, to plan its own industrial and political development as scientifically as stolid monarchic Germany has done; nor lastly, to the fact that even enlightened Germans themselves are beginning to recognize that too much scientific education, too much scientific planning, too much governmental control, may clog the mind, and prevent a buoyant exercise of a man's powers. If there is little real daring in German enterprises, little of the adventurous buccaneering spirit that prompts an American to stake everything upon one cast of the industrial die, the reason is to be found not in any lack of courage in the German, but in his education and in his orderly mode of doing business. Scientific discoveries are rarely made by pouring the contents of one test tube into another at haphazard. Neither are many business enterprises successful simply because a manufacturer is willing to leap into the dark. The German takes no chances. His education has taught him the value of logical procedure in business as well as in the laboratory. We hope by publishing the articles in question to show the American manufacturer that a chemist or a physician, or a bacteriologist, may mean more in the upbuilding of his own business than a new piece of machinery, or a reduction in the scale of wages, or a cheapening of the rates of transportation. We Americans are beginning to realize that we must husband our natural resources that the days of reckless extravagance in the use of raw materials are over. In a few years, many a small manufacturer will wonder why it is that he has been forced into bankruptcy. He will attribute it, no doubt, to that keenness of competition which it now seems the purpose of our Government to restore to its medieval glory, and perhaps to his inability to cope with vast aggregations of capital. He will probably attribute his downfall not to the money of his rivals, but to his own inability to utilize his raw material with Teutonic and scientific completeness, to get the most out of a shovelful of coal and a handful of corn.

Germany owes her commercial success to her remarkable system of education, to the Government's co-operation with manufacturers, and lastly, to that army of men who watch the boiling of many colored liquids in glass retorts, whose eyes are glued to microscopes day in and day out, and who make everything according to a scientific method, whether it be a battleship or a tin whistle. The story of that success is a story of science, a story that we intend to tell in the SCIENTIFIC AMERICAN.

Physical Tests for Aviators

THE physical testing of engine drivers and other employees has long been an established policy of railroads. It has been recognized that the safety of hundreds of lives and of thousands of dollars worth of property may depend not only upon the skill and endurance of one man, but upon his physical fitness for his task.

Moreover, defects may exist in either sight or hearing of which the victim is himself more or less unconscious. Keenness of vision and sensitiveness of color perception, for example, are requisites in the case of engineers, switchmen, and others. Yet either may be impaired or congenitally defective, and the man never know it. A very remarkable instance of this is the case of the redoubtable General Lee Christmas, who is said to [illegible] driven by his inability to distinguish [illegible] fering colors to his picturesque and [illegible] career as a soldier of fortune through [illegible] ing disappointment and despair at [illegible] cut off from his cherished ambition of [illegible] a railroad engineer.

Thus far the chauffeurs of automobiles [illegible] been subjected to similar tests. In fact [illegible] of late that there has been a strong [illegible] for certified proof of a reasonable amount of mechanical knowledge and experience in [illegible] their part. Yet it is probable that many [illegible] and other accidents have been due to [illegible] infirmity of the driver.

But if a proper corporeal equipment is necessary to the motor-car driver or the engineer [illegible] one plane and in tolerably uniform [illegible] is absolutely essential to the air-pilot, [illegible] move in three dimensions and who is subject to the most varying conditions of temperature, [illegible], and air-pressure.

"Know thyself" becomes the very law of life to the aviator, and doubtless much of the appalling loss of life among aeroplanists might have been avoided had the too reckless birdmen been aware of their own physical defects and limitations. Given that the aeroplane has demonstrated its ability to carry a very considerable number of passengers—a Sommer biplane has recently carried six full-grown passengers on an hour's trip across country—public policy demands that a physician's certificate of physical soundness be required of applicants for a pilot's license.

A special study of this subject has been made recently by an Italian physician, who has reported some very interesting conclusions to the *Hygienic Gazette*. As a first requirement he observes that would-be pilots should have perfect functional action of the organs of the respiratory and circulatory systems, and of the nerve-centers, since all of these must be subjected to great exertion, strain, and disturbance.

Precision of movement of the limbs is highly important, and so is the ability to jump or leap with accuracy, a quality which depends not only on legaction, but on flexibility of trunk and clearness of sight. Resistance to shock should also be tested, as should keenness of vision for white and for colors.

Soundness of the auditory organs is a particularly vital matter. In the first place the hearing should be normal because upon this faculty especially devolves the noting of the proper and uninterrupted action of the motor. Also, a healthy state of the drum and middle ear, the free play of the chain of small bones, and an unobstructed condition of the upper air passages and the Eustachian tubes are indispensable conditions for the defense of the anatomic and functional integrity of the ear against the effects of the variation of the pressure of the air and of sundry meteorological agencies.

Most vital consideration of all, perhaps, is the integrity of the labyrinth of the internal ear, and especially of the three semi-circular canals. It has long been known that these canals, which are disposed in three separate planes, constitute a very delicate organ of equilibrium. The nerve-filaments they contain float in a liquid, any disturbance of whose level is at once conveyed to the brain. The peculiar gyrations of the waltzing mice of Japan are due to an abnormality of these canals.

In this connection Professor Nicedu-Semidel made some especially interesting observations, one to the effect that the sense of dynamic equilibrium is made more sensitive by exercise. In one instance an aspirant for a pilot's license showed marked errors and illusions of direction. On examination of his ears there were found traces of a previous purulent ear-trouble resulting in diminution of hearing and functional trouble of the semi-circular canals. When asked to walk in a straight line with his eyes shut he constantly bore to the right. This deflection was still more marked when walking in an arc of a circle, the circle enlarging at each turn if the trajectory was convex toward the right and decreasing correspondingly if toward the left. The observation of this case led the physician to formulate the circle test for the examination of the functional operation of the semi-circular canals in would-be pilots.

If the pilots of dirigibles and of floating balloons require less rigid tests in some respects, in others they are more liable to disturbance because of the greater heights at which they commonly move and because of the much longer duration of the flight. For them, heart and lung power are of greater import, skin sensitiveness should be considered, and gastric irritability may play a significant part in the diminution of strength and resistance and the general loss of staying power.

Self-dumping and Automatic Baling Scow

A New Type for Refuse Disposal and Harbor Construction

THE handling of waste materials and refuse from a great city is a vast problem When it is understood that New York city must dispose of at least 6,000,000 tons a year, or almost 20,000 tons per day, and that all or nearly all of this material must be transported to sea and dumped in not less than twelve fathoms of feet of water, which means a tow of from 22 to miles from the Battery, some idea will be gained of the magnitude of the undertaking

At the present time and for a number of years in the future there will be added to this a vast quantity of excavation resulting from subways

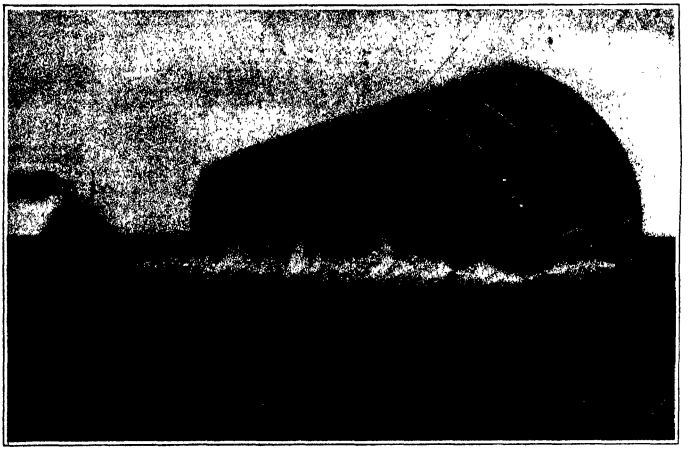
While a considerable portion of this material is transported within the harbor limits and used for solid fill in reclaiming waste land and shallow water, all of it will have to be transported on some kind of water craft. At the present time there are only two classes of vessels handling this material—the ordinary deck scow carrying the material upon the flat deck, from which it is unloaded either by hand or mechanical device, usually a grab bucket, and the so-called dump scow or bottom dumper, constructed with certain pockets or openings through the center which are closed by swinging doors in the bottom, retained in place by chains and mechanical devices. Into these pockets the material to be transported is delivered, and when the scow has been removed to sea or to some other part of the harbor where the material is to be used, the gates are opened and the material delivered through the bottom

While each of these devices is particularly fitted to do the work for which it was designed, neither can do the work of the other The unloading of the deck scow is a slow and tedious matter, either by hand or with mechanical device, and it is practically impossible to unload the dump scow otherwise than through the bottom. The dump scow is further handicapped by not being able to handle certain material, such as earth containing more than ten per cent of rock or mixed with boards, timbers or other refuse, which would either bridge across the openings when the bottom doors are opened or fail to leave the scow through the bottom, due to entanglement or a tendency to float The bottom dumper is further handicapped by the fact that if loaded in very cold weather, the bottom layers will freeze and the whole mass gradually assume such a condition as to be immovable until warm weather returns, or, as a last resort, by the use of dynamite, which will more often destroy the scow and render it useless without extensive repair

The reluctance of the bottom dumper to deliver all of its material through the bottom, has given rise to the practice of the towing captains called "bumping," which means, after the gates have been opened and the material refuses to leave, the tug is used as a battering ram, repeatedly butting into or bumping against the scow to dislodge the reluctant material. As the unloading usually occurs at night and far out at sea, often in heavy weather, and as the captain dislikes very much to return to port with half a cargo, the practice often results in discharging some of it through the hole made by the tug Besides the work of handling refuse from cities, there is a vast amount of work in handling rock for breakwaters in making new harbors and improving old ones

The craft herewith illustrated is intended to retain the deck-loading feature of the ordinary deck scow and to make possible a very much superior and more certain means of unloading In other words, the material is loaded on the deck in the ordinary manner and towed to any place within the harbor, and the material removed by mechanical means from the deck, or it may be towed to sea, when, by the manipulation of certain valves from the interior, it will turn completely over, depositing material positively and quickly and with every assurance that none of the load will be brought back

By referring to the drawings it will be seen that the scow is practically rectangular in cross-section, with rounded ends As it is intended to work either





NEW TYPE OF SELF-DUMPING SCOW

side up, the bow is required to be vertical The interior is divided by four longitudinal watertight bulkheads, one near each bow, extending from the bottom to the top of the scow, and two intermediate bulkheads extending between two false bottoms which are located from six to nine inches above the light draught water line of the scow

The scow is framed longitudinally with heavy trusses on four feet centers, well braced diagonally and secured vertically with tie rods The framing is of exceptionally heavy scantling throughout, well braced and stiffened with knees and breast hooks at bow and stern.

The larger drawing shows the operating machinery Considering the scow as loaded down to full load line with two feet freeboard, the operating wheel in the drum is turned, and through the transmission mechanism the valves are opened, admitting water to the space between the two false bottoms This water, being free to flow from side to side, gathers at one side and gradually lists the scow until it assumes the position shown in the third of the smaller engravings, where it has about reached the point of unstable equilibrium. The continued entrance of the water causes the scow to gradually turn up on edge, and finally fall over to the position shown in the fourth of the small engravings, finally coming to rest in the reversed position

There are valves or openings near the top and bottom of each compartment All these valves are opened at the same time the upper valves, when the scow is loaded, allowing the air to escape as the water enters at the lower openings

When the scow has reversed itself, the water which has entered will run out through the lower openings, due to the fact that the reserve buoyancy below the false bottom is sufficient to raise the bottom or deck six or eight inches above the light water line, after which the valves may be left open and closed at any time before the scow is reloaded

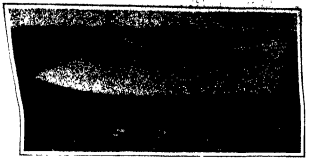
Perhaps the most novel feature of this scow is the arrangement by which it is possible for the operator to remain within the scow while it is being reversed, and it was of course, a matter of great interest as to how rapidly the scow would turn Repeated timing has shown that from the time the valves are opened until the scow assumes the vertical position on edge, fifteen seconds elapse

As the drum is 8 feet in diameter during this time the operator has to move one quarter of the revolution or 6 feet and while the remaining quarter turn is completed in from two to three seconds, the operator travels another 6 feet around the circumference of the drum, steadying himself by grasping the central spindle about which the operating wheel turns The whole turning movement is surprisingly slow and deliberate

Severe Hail-storms

THE destructive effects of large hailstones are most frequently experienced in subtropical regions at a considerable altitude above sea level Some of the most severe hailstorms have occurred in India At Belgium, December 22nd, 1884, 12 persons were killed, 78 injured, and 170 head of cattle and 560 sheep destroyed by hail In the State of Bihor, October 5th, 1893, the hail covered the ground to the depth of 4 to 6 feet, 6 persons were buried beneath it and perished, while 835 head of cattle were killed The most severe of these visitations occurred May 1st, 1888, when in the Moradabad district alone about 250 persons perished

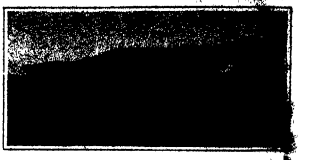
In the United States one of the worst storms of this character occurred September 5th, 1898 in Nodoway County Missouri The path of the storm was about three miles wide and eighteen miles long, its greatest violence being felt over a region of four square miles east of Clarmont At one point in this region the fall of hail was so heavy that a drift unprotected by any artificial means remained lying on the ground for four weeks after the storm At the end of that time people in the neighborhood were found gathering the hail for the purpose of making ice cream During the storm cylindrical pieces of ice were picked up four inches long by about two and a half in diameter The growing corn was practically all destroyed; in a field of eighty acres only one stalk was left standing.



Noting the deflection of the plane.

The Strength of an Aeroplane

A Family Hydroplane



A plane loaded with gravel.

SINCE the successful launching on September 7th, 1911, of the hydro-aeroplane of the United States Navy, by sliding it down a wire, Mr Curtiss has given his attention to new experiments in aviation of no less interest

On October 2nd he made a test of the stresses in the stay wires of all the panels of the main sustaining surfaces of his standard biplane, in order to compare them with the stresses, determined by computation and by graphical construction To this end he turned the aeroplane upside down, supported it at its middle, and loaded the entire main planes with sand distributed in such manner as to produce in the guy wires the same stress as in ordinary flight

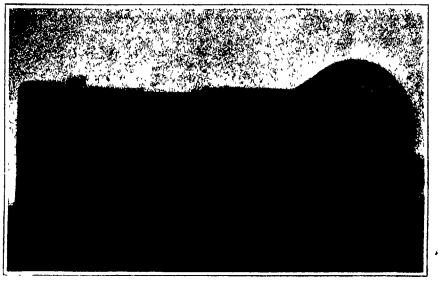
When subject to their full stress each wire was tested by means of a pair of tension tongs These look like ordinary blacksmith tongs except that each jaw is slitted so as to pass over the wire to be tested and grip it when the slits are closed by tightening screws When the jaws were thus attached to a wire, the handles of the tension tongs were drawn together just enough to cause the bit of wire between the jaws to lose its stress, and slacken The force on the long handles was then measured by a spring balance, which in fact caused them to exert the required stress, and the tension in the wire was found directly as the product of the force indicated by the spring balance multiplied by the ratio of the distances from the tongs pivot respectively to the spring balance and to the wire under test

It had been previously shown by analysis and by graphic statistics, that in a biplane whose surfaces have practically a uniform running load from center to either wing tip, as may be roughly assumed to be true in ordinary usage, the stress in the outwardly and upwardly sloping stay wires of the end panels, or wing tips, sustain but one-fourth as much tension as the corresponding wires in the second panels from the end, while those wires which slope outwardly and downwardly sustain no material tension due to pressure on the concave side of the wings, though they may be very severely strained when the machine is jolting over rough ground In the third section from either wing tip, known as the engine section, the tension in the guy wires and oblique stay rods is still greater, being more than five times the tension in the wires of the end panels

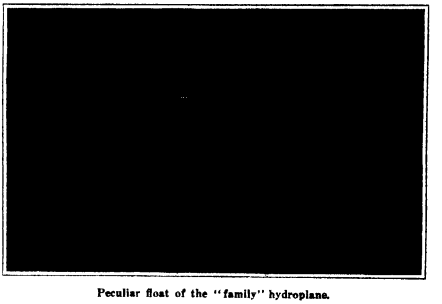
Though the test was made for practical rather than scientific purposes, the stresses were found to increase from the wing ends to the engine section approximately as indicated by theory It was observed also that each wire had a large factor of safety, ranging from about ten to thirty Mr Curtiss then added his weight of 150 pounds to one wing tip, while an assistant of equal weight stood on the other wing end The stress in the wires of the second panel was then doubled

Other tests were made on the ribs of the main planes It was noticed that they were sprung by the load of sand sufficiently to change the tension perceptibly in the fore-and-aft diagonal wires. Mr Curtiss had a panel of the main planes placed upside down with its spars resting on trestles placed transversely to the ribs When uniformly loaded with sand weighing ten times the usual pressure on the wings, these collapsed, due to breakage of the ribs From these various tests it was concluded that the weakest part can endure ten times the stress it usually has to sustain in ordinary flight

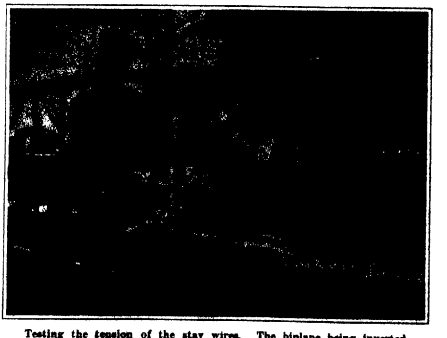
During the month of October Mr Curtiss developed a new type of hydro-aeroplane, intended for pleasure and sociability This has been called a "family hydro." The machine consists of a biplane mounted directly on a single boat of unusual size without intermediate framing so that the lower plane rests directly on top of the boat amidships The passengers will sit on the bow of the boat just before the lower plane The engine will be mounted just underneath the upper plane so as to allow the propeller on its crankshaft to swing freely without too near exposure to the bow of the boat and the spray thrown up when the latter is skimming the water rapidly. The usual floats at the wing ends will be used to preserve the lateral balance when the vessel rests quietly on the water or runs over its surface. The final goal is an aeroplane which can be manipulated as readily as a motor boat, which can be launched from smooth or rough water alike, and which, after a substantial voyage in the air, may be landed on earth or water with ease and security A novel wind-tube for studies in aerodynamics was developed in the Curtiss aeroplane factory during October, 1911, and found its first application in revealing the stream-lines about the wings and body of a small model of the new hydro-aeroplane. The wind-tube, which is but the model of a full-sized wind-tunnel to be built later, is shown in the photograph. It measures six feet in length by fifteen inches square in cross-section, and is provided with a glass door through which models can be introduced and studied in the air stream As usual the current of air is generated by an electric motor driving a suction fan or screw at one end of the tube, while at the other end is inserted a honeycomb structure for causing the air to flow in straight lines free from swirls and eddies The "honeycomb" in this case is a standard aeroplane radiator having cells four inches long by one-fourth inch square in cross-section. The air enters the tube through this straightener at a part of the room free from obstructions and well above the floor As a consequence it moves in a smooth current of uniform velocity. A fine silk thread suspended in the current shows a deviation of the stream-lines of but a small fraction of a degree to and fro from exact parallelism with the walls of the tube The speed of the air, tested when the motor was not perfectly steady, showed a diminution of nearly two per cent across the tube at the middle of the window, when explored from mid section to within less than two inches of the walls, but in the stratum extending from the walls inwardly 1.5 inch, a considerable variation of wind speed was observable, due no doubt to skin friction on the four feet of wall between the radiator and the section in question A cone was placed at the motor end of the tube to incase the 30-inch suction screw, and a like cone may be placed before the radiator, if thought advisable, to improve the flow of air.



Wind tube with radiator for straightening stream lines.



Peculiar float of the "family" hydroplane.



Testing the tension of the stay wires. The biplane being inverted and loaded with gravel.

This wind-tube is so simple and effective that it may be found serviceable to other aviation students who may wish to make like experiments. But of course it is desirable to have very much larger tubes, equipped with proportionately large radiators, since a small model may easily disturb the stream-lines as far as the walls of a small tube, and thus give different indications from those for freely flowing air. The radiator not only makes an efficient straightener, but also may serve to keep the air at any desired temperature, if a suitable fluid be made to course through it. This remark applies particularly to a wind-tube having a closed circulation of air.

Two methods are used by Mr. Curtiss to delineate the stream-lines of the air current flowing past any model inside the wind-tube. One is to attach a fine silk thread to a fine wire, and hold it at various points about the model; the

(Continued on page 556.)

Curiosities of Science and Invention

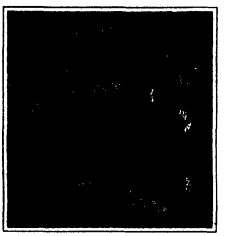
Recovering a Current of 800 Amperes at 13,000 Volts

A paper recently read before the Schenectady Mid-year Convention of the American Institute of Electrical Engineers, D. Merriam discussed the problems of oil-break circuit breakers. The oil circuit breaker interrupts an electrical circuit in oil without producing abnormal disturbances in that circuit and also confines the destructive arc to a small volume, thereby preventing its spread to adjacent apparatus and enabling the oil circuit breaker to be safely placed in any convenient location on the switchboard or in the power station. Air break circuit breakers, owing to the large vicious arcs which they produce, are unsuited for general alternating current circuit breaking applications. The illustration herewith shows an arc drawn by one of these devices when opening a circuit carrying 800 amperes at 13,000 volts. This arc, one of many observed, was about 180 inches long and rose 140 inches in the air, while the same circuit ruptured in oil produced an arc only 9 inches long and with no external disturbance.



Courtesy General Electric Review

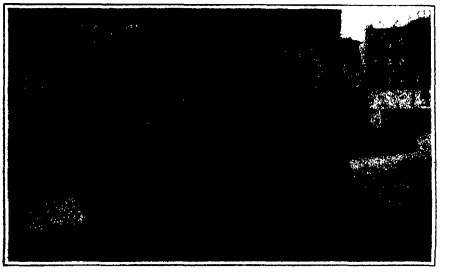
A 180-inch arc drawn out by an air switch.



Getting standard time by wireless from the Eiffel Tower.

Pneumatic Spring for Automobiles

We illustrate herewith a pneumatic cushion which has with considerable success during the past year been used to take the place of springs in automobiles, and which is now being tested on the commercial vehicle. The cushions consist of rubber bulbs, each with an outlet through the neck at the top, connecting with a good-sized air reservoir. The cushions at the front have a separate air tank from those at the rear. A pressure of but 27 pounds is used in the front cushions, which are 8 inches in diameter, whereas 43 pounds to the square inch is the pressure used in the rear 10-inch cushions. This pressure is sufficient to support the weight of a 3½-ton express truck, fully loaded. In the future, a single bulb will be used in place of each spring, these bulbs being 9 inches in diameter in the front, and 12 inches at the rear. According to the superintendent of the express company which has been testing these cushions on one of its trucks for the past two months, the cushions absorb the road vibrations of the running gear and cause the wheels to cling to the ground, giving better traction. The result is twofold—a decided diminution of the wear and tear on the engine and transmission, and longer life of the tires because they do not bounce so much. The saving on the machinery and tires is estimated to be as much as twenty-five per cent in both cases. Another good point of the cushion spring is that it will not crystallize and break as steel springs frequently do. This is a decided advantage, especially with a commercial vehicle, where the breakage of a spring generally causes great delay.

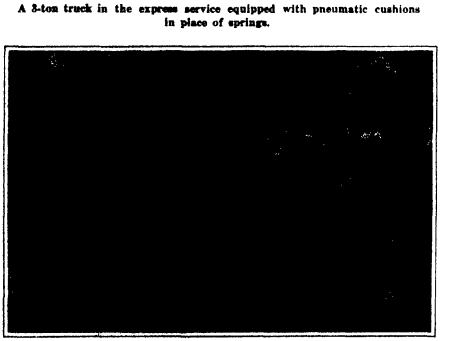


A 3-ton truck in the express service equipped with pneumatic cushions in place of springs.

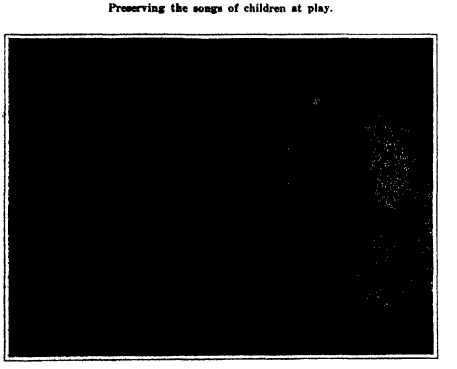
A Museum of Speech

For more than a year, a Parisian professor, Mr. Ponge, has been engaged in creating a very original museum, for the collection and preservation of records of the human voice under all of its manifestations. In this museum of speech there will be in addition to the original records, wax copies and microphotographs of the contour and relief of characteristic phonograms; also studies of the organs of speech as well as photographs of speech (Marage process).

With the help of these data, the museum of speech will make a phonetic chart of French speakers. Thanks to these files it will be possible to notice almost imperceptible differences between the same words in the *patois* of two neighboring villages, or of two successive generations. Just now Mr. Ponge is using the phonograph to preserve the children's songs and the cries of the street as well as the speeches of the great orators, the sermons of the celebrated preachers, the arguments of illustrious members of the bar, etc. One of the photographs shows him at work in a school among the children playing and singing a child's song. Another of our views shows him in the street recording the cry of an asparagus vendor. He has a fertile field for work among street criers. There is the hawker of straw goods, the mender of chairs, the china and porcelain merchant, the cask maker rolling his barrel as he goes along, the glazier and other small merchants whose "speech" he records for minute study.



Preserving the songs of children at play.



Recording the cry of an asparagus vendor.

Setting a Watch by Wireless Time Signals

Now that time signals are being sent out from the Eiffel Tower periodically, amateur wireless telegraphers have seized the opportunity to set their watches by means of these signals. Obviously, this form of signal has its advantages over that of the time ball in common use here. The signal is sent out broadcast and any one may receive it in his own home, not only in Paris but in suburbs and neighboring towns. The receiving instruments of wireless telegraphy are very simple and inexpensive, and any boy can make them out of materials at hand, practically the only expense being that of a good telephone receiver. The accompanying photograph shows a rather more elaborate set of instruments than is absolutely necessary, and the operator, with telephone to his ear and watch in hand, is waiting for the signal from the Eiffel Tower. A system such as this should do much to set a standard of time over a large area at but little cost.

Mesmerizing Lobsters

Bizarre information may occasionally be gleaned from the most serious scientific literature. The title of the *Report of the Northumberland Sea Fisheries Committee for* 1910-11 suggests routine statistics on trawling and seining, sea temperatures and salinity, plankton and the like, hence it is somewhat disconcerting to find therein more or less valuable directions as to the best way to mesmerize lobsters. "The usual method (we quote from *Nature*) is to hold the lobster head down, with the claws arranged so as to form a support with the rostrum, and to stroke it rapidly with the tips of the fingers," i. e., to stroke the back of the carapace, or shell covering the crustacean's head and thorax. "In about a minute the lobster succumbs, and remains without movement in this position for a variable period. In order to see whether the reversed position, as driving the blood to the head, was essential, a lobster was treated in the horizontal attitude, and so successfully that it remained without movement for three hours. A Norway lobster subjected to a similar treatment was quiescent for fifty-minutes. A lobster can be put to sleep on its back. Other crustaceans are amenable to the same treatment. The crab goes to sleep usually in the tucked-up condition, and may be left in the natural position or on its back. They all recover when disturbed, but the recovery of the lobster appears to be quicker if the under surface of the cephalothorax is disturbed. Placed in sea water lobsters recover immediately, but in one such case a crab took ten minutes to come round completely."

The process is beautifully simple, and—such are the vicissitudes of life—one can never tell when the foregoing information might "come in handy."

Abstracts from Current Periodicals

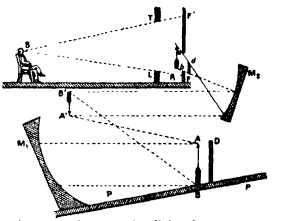
Phases of Science as Other Editors See Them

Living Persons Represented on a Reduced Scale

THE idea of projecting on a screen living figures larger or smaller than life was realized more than a century ago, but the weakness of the available sources of light made the representation very imperfect Even the electric arc gives unsatisfactory results when lenses and a screen are employed, but by suppressing the screen and forming aerial images by means of concave mirrors, a very brilliant and realistic effect can be produced

An exhibition of this kind has been on view in Paris during the past year At one end of a darkened hall is a little stage with a curtain about five feet wide and three feet high The raising of the curtain reveals a "back drop" and side scenes of the usual type, and personages who move and speak in a very life like manner, but are only twelve or fifteen inches tall The following explanation of the trick, which we quote from *La Nature*, is conjectural, as the exhibitors refuse to give any information

The illusion is probably produced by two concave mirrors which are really above the floor, but are shown below the floor in the diagram, for the sake of clearness The real actor, indicated by the arrow *AB* stands before the mirror M_1, which forms a reduced and inverted aerial image of him at *A'B'*, and the second mirror M_2 forms a re-inverted and still further reduced aerial image at *ab*, on the stage, and in view of the spectator *S* The rays which form the image pass through an opening in the back scene, and the part of the scene which is thus cut out is painted on a larger scale, on a screen *D*, placed behind the actor *AB* This part of the scene and a portion of the floor *P* are thus projected with the actor's figure The actor's movements are necessarily restricted to a small area, but he can make gestures and dancing steps without getting out of range or focus The illumination, as well as the distances, dimensions and positions, requires very nice adjustment The actor and the projected scene *D* are necessarily illuminated by a powerful electric arc, while the back drop and side scenes of the little stage are lighted by rows of incandescent lamps, and the illumination must harmonize in order to produce a realistic effect These difficult problems have been solved with wonderful success



Apparatus for projecting living figures on a reduced scale.

Paintings Locked to the Wall

THE attempt occasioned by the recent theft of the "Mona Lisa" from the Louvre has drawn attention to the insufficient protection of paintings which are simply hung on the walls of our great art galleries, and can be detached by a twist of the hand on the part of a person more enterprising than scrupulous

The idea occurs naturally enough in some way to lock the paintings to the wall This is what the inventor of the device shown in our illustration herewith does

A horizontal bar of rectangular cross-section extends along the wall, its ends being placed in bearings which allow the bar to rotate so as to present either its narrow edge or its flat surface in plan view The paintings are provided with slotted ears, into which the horizontal locking bar can be inserted when in its "edgewise" position The bar is then turned flat and so locked by means of a lever (shown in Figs 2 and 3) The picture is then held firmly to the wall The device seems practicable enough, and should find extended use, though possibly to some tastes it may be objectionable at least for private residences, on esthetic grounds

Mining in the Stone Age

ALMOST interesting glimpse into prehistoric mining in the Stone Age has recently been revealed upon the opening of the Oural and Aram copper-cobalt mines in Spain according to the *American Antiquarian*

"In these ancient Spanish mines," states our contemporary, "the galleries and drifts do not open directly onto the mountain side. Instead they communicate with daylight by means of several vertical shafts or chimneys, a few meters in height. The purpose of this arrangement was, it has been suggested, to effect a better control over the slave-miners Perhaps, too, the purpose was to prevent wild animals from making their home in the mine along with the slaves

"Relics found both inside and outside the mine comprise bones, and various implements made of stone, bone, horn, fire-clay or of wood. Among the principal relics found on the interior were sixteen skeletons, two of them complete, stone hammers, picks made of horns of animals no longer known in Spain, stone needle, torch sticks, a bone knife, two wooden bowls, and, strangely enough, some coins. The skeletons which were found belong for the most part to miners suddenly killed in the midst of their labor, the hand still holds the hammer, and occasionally a skeleton is found under a fall of rock Other corpses met death in a cowering or crouching position

"All of the men must have been of extraordinary muscular development The heavier stone hammers which they used weighed as much as twenty or twenty-two pounds In spite of their muscular development, the majority of the miners were evidently of extremely slim build, for some of the galleries are literally polished by the rubbing of bones, and in these galleries, penetrating through the solid rock, a man of even small size can worm his way only with the greatest difficulty The skulls have the appearance of youthful individuals or of children, but, considering the differences in skull and brain development in those days as compared with to-day, this appearance may be deceptive

"The stone hammers, more or less polished, were often used by being held directly in the hand, without any sort of handle In some hammers a wooden helve is preserved and in a few a thong served as handle

"For illumination, the miners used sticks of wood four to eight inches long A ball of wet clay was rolled and slapped against the gallery wall Into this clay the miner stuck his little light Numbers of these wooden sticks or matches, the free end charred, are still preserved in place in their clay holders along the galleries There are also found some resinous branches or twigs, wrapped in hide, and the latter soaked with grease or with resin These, it is believed, also served for illumination, perhaps, too, for heating purposes

"Fire was used to splinter the rock, and to [illegible] it more friable and easier to attack. The clay [illegible] the vein walls was picked away by hand. Thou[illegible]ds of finger prints are still visible here; they show [illegible] that the thumb of the miner of these days was of t[illegible]endous size, almost double the length of the thu[illegible] of present-day workmen

"No props were used in the workings, which [illegible]not alone proves that they antedated the Romans, [illegible]n certain cases ore was extracted from the end o[illegible]gings into which to-day only a child would be [illegible]e to penetrate. Several galleries are so steep an[illegible]so slippery that any movement in them must have [illegible]n with the help of thongs fastened into the roof of [illegible]e gallery; in the-vertical stopes or raises there is [illegible]ually still preserved a stone ring into which such a thong was fastened

"Originally, the ores were smelted in shallow, scooped-out hollows in refractory clay. These primitive crucibles were about 8 inches in diameter, and with walls 1½ inch thick, fragments of them are preserved with ore, incompletely reduced, clinging to their sides Later they must have employed a more highly perfected smelting device, for pieces of quite homogeneous slag are found, this denotes the use for some continuous smelting apparatus."

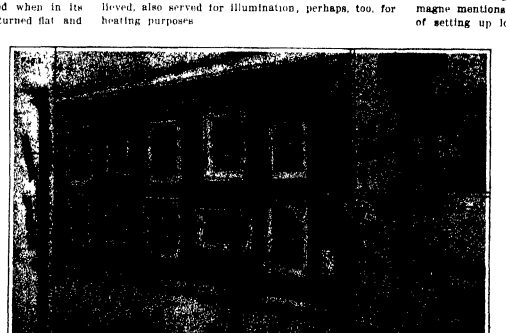
Was Benjamin Franklin the First Inventor of the Lightning Conductor?

TO some it may seem almost a sacrilege to raise the question which appears at the head of this note. Perhaps it may not be amiss to say right at the outset that investigation of the evidence leads to a substantiation of the ordinarily accepted view which gives to Benjamin Franklin the honor of having invented the lightning conductor Nevertheless, it is interesting to note a number of passages in ancient literature and records which have by some been construed as anticipating the modern method of warding off the lightning This subject is discussed by an anonymous writer in *Die Welt der Technik*

Very soon after Franklin's invention became known, a French professor drew attention to ancient Tuscan and Roman instructions, which spoke of "calling down" lightning (*elicere*), and further pointed out that the ancient Romans had a regular rite for Jupiter *elicius* (Jupiter called down from heaven) It was argued, therefore, that the Tuscans and Romans knew, even at that early period, of the possibility of drawing down the lightning from the clouds The Celtic nations also were in the habit of sticking their swords in the earth with the point upward, near springs, on the approach of a thunder storm, as a protection against lightning The Persian King, Artaxerxes, was acquainted with the power of iron to attract lightning Again, Josephus Flavius, in describing the great temple of Herod in Jerusalem, states that the roof was studded with an army of golden points, and that a similar arrangement was found on the earlier temples of Solomon and Zerubbabel It is stated that none of these temples, in spite of their location upon an altitude, was ever struck by the lightning Coming down to the Middle Ages, it is noted that an edict of Charlemagne mentions that the peasants were in the habit of setting up long pointed pole in the ground on the approach of a storm, and in a sermon of St. Bernardinus of Siena it is mentioned that sailors would bind a sword with its point directed upward to the mast of their vessel on the approach of a storm

Apparently a very good case could be made against Franklin. Dr. Hennig, however, puts down all instances of this kind to pure superstition. The idea was to frighten away the storm demons by means of the upwardly-directed swords Among uncivilized peoples it is a common custom to threaten approaching storms by the din of arms, and the ancient Gauls and Romans would shoot arrows into the gathering storm clouds, to ward off the hostile powers of the weather.

As regards the golden points upon the temple at Jerusalem and other places, Josephus himself tells us that the purpose of these points was to keep off the birds.



From London Illustrated News

Locking the stable after the horse is gone.—The theft of the "Mona Lisa" has inspired this invention.

Engineering

...n the "Maine."—The work of uncovering the "Maine" is completed, and the report of the engineers and ... Board who made the investigation has been ... to the Secretary. In the opinion of the Board ... amination of the bottom of the ship in the region ... explosion presents evidence of a primary ex... ... external to the ship, and in all the main feat... the recent investigations have fully corroborated ... report of the Naval Board of Inquiry, made at the ... of the disaster.

...t Medal to Sir William H. White.—At the Nine... ... Annual Dinner of the Society of Naval Archi... ... and Marine Engineers, held at the Waldorf-A... ...ria, Sir William H White, former chief con... ...tor of the British navy, was awarded the John F... ... medal for notable achievement in naval archi... ...re. The venerable American steel pioneer, in whose ... the medal was founded in 1902, was present, in ... of his 89 years Previous recipients of the medal ... Lord Kelvin, George Westinghouse, Alexander ...ham Bell, Thomas Alva Edison, Charles T. Porter ... Alfred Noble

...monument to Fitch.—In connection with the River ...ntennial Celebration, recently held in Pittsburgh, ...ere has been a movement to give a long-delayed but ...ell-deserved tribute to the work done by that inter...sting but very erratic character, John Fitch, in pro...moting the early development of the steamboat. Fitch ...as a typical American inventor, with all of his char...acteristic faith and perseverance His boat was the ...st to run on a regular schedule, carrying passengers ...This is a fact which cannot be disputed A newly-or...anized chapter of the Daughters of the American Rev...olution will be named in Fitch's honor and will erect a ...suitable monument to his memory

Lignite Briquette Experiments.—The Bureau of Mines, realizing the value of the vast deposits of lignite which exists in several western States and particularly in North and South Dakota, Montana and Texas, recently obtained from Germany a powerful briquetting machine, which is being used to determine the suitability of American lignites for the manufacture of briquettes The experimental work so far done has shown that lignite can be made into satisfactory briquettes at a cost that renders the manufacture commercially profitable The extended use of lignite briquettes would serve as an important factor in the conservation of our supplies of coal

The Hell Gate Bridge.—The letting of the contract for the imposing Hell Gate railroad bridge, which will serve to connect Long Island with the mainland at a point near the Harlem River, marks the beginning of work on the most imposing structure of its kind in this country, and the longest bridge of its type in existence. Its dominating feature will be a massive arch bridge of one thousand feet span, carrying four tracks capable of accommodating the heaviest railroad freight traffic The total length of the bridge, including approaches, will be three miles In the steel arch bridge alone there will be 18,000 tons of steel, and there will be a total of 70,000 tons in the whole structure.

The Panama Canal Fortifications.—With the exception of one of the fortifications at the Atlantic terminus, the defensive works which are being constructed at the Panama Canal will be named in honor of soldiers conspicuous in the Civil War. One of the Atlantic works will be called Fort De Lesseps The sea-coast fort at the Pacific terminus will be known as Fort Grant, and its batteries will bear names of division commanders of the northern army The sea-coast forts of the Atlantic terminus will be known as Fort Sherman, Fort Randolph, and Fort De Lesseps, and the batteries of Fort Sherman will be named after division commanders who served under General Sherman The batteries of the other two forts will bear the names of artillery officers who distinguished themselves in the war

Improving the Port of Para.—Although Para, the commercial metropolis of the Amazon valley and the greatest rubber-exporting center of the world, has long enjoyed an immense trade, this has been seriously hampered by two circumstances, viz., poor harbor facilities and the unhealthfulness of the town Recently the Brazilian government has taken seriously in hand the improvement of the harbor, and has nearly completed works the total cost of which will amount to about $39,000,000. Whereas formerly large vessels, owing to the shallowness of the water, were obliged to lie some miles from the quays, a considerable part of the new quay wall will have a depth alongside of from 30 to 32½ feet. Docks, ship-railways, metallic warehouses, electric cranes, and buildings for the customs, postoffice and national telegraph are included among the improvements. Meanwhile the state of Para is endeavoring to improve the hygienic conditions of the city, and especially to eliminate the particular type of mosquito which is the carrier of yellow fever.

Electricity

Street Car Telephones.—In order to avoid needless opening of car doors in winter weather, the street cars of Chicago are to be equipped with annunciator horns set at the four corners of the car in the ceiling, and connected with a telephone on the rear platform, by which the conductor may announce the streets

Wireless Messages to Flichner.—According to *Petermanns Mitteilungen*, wireless communication is likely to be established between the Argentine wireless station on New Year Island (near Cape Horn) and the "Deutschland," the vessel of Lieut Flichner's antarctic expedition, after the latter reaches the barrier ice and Weddell Sea.

Wireless Lighthouse Signals.—The new lighthouse at Ouessant, on the Channel coast of France, is noteworthy not only for its height of 120 feet and its powerful light, but also for the wireless signals which it is to send out The new apparatus is designed to give vibratory wireless waves so as to produce musical signals in the well-known way Two different notes, *do* and *sol* are used here, and they will be repeated at regular intervals so that such signals can be easily recognized by vessels at sea Following this, other stations of the kind are to be erected along the Channel

Cairo-Heliopolis Electric Line.—The new electric traction line running from Cairo to Heliopolis, Egypt, is laid out in two sections, the first lying between Boulac and Limoun Bridge and the second running from here to the second oasis The line is built on narrow gage (3 feet 3 inches) and runs trains made up of motor cars Each of the cars is fitted with four motors of the 50 horse-power Jeumont type, of French build, running on overhead trolley wire For this latter the voltage varies between 500 and 700 volts according to the section of road

Limited Current for Small Consumers.—The electric lighting station of Bremen, Germany has adopted a method for the sale of current by which it hopes to reach small consumers and induce them to abandon oil lighting For instance a workman's family living in a small lodging can make a yearly subscription for current to the amount of three 16 candle-power lamps per day, and for this he pays about the same price as for oil He is entitled to the use of the lamps continually, but more than this number cannot be turned on, as a current limiter prevents this However, nothing prevents wiring the quarters for a larger number of lamps, provided not more than the stated number are turned on at a time.

The Cost of Ultra-violet Sterilization of Waters.—A report has recently been made by Grimm and Wedert on the cost of sterilizing water by means of ultra-violet rays produced in a quartz lamp The cost for 50,000 hours' work was, for the quartz lamp $50 resistance $11, new burners $600, current $1,100, sundries $14, or a total of $1,775 This outlay represents the cost of sterilizing 5,000,000 gallons of water, or about one cent for 30 gallons The cost of complete sterilization is relatively much greater than that of partial sterilization By sterilizing the water within 99 per cent complete, the cost can be reduced to 90 gallons for one cent As compared with this the ozone system of sterilization would cost half as much, and ordinary filtering one-tenth as much

Federal Electric Railroads in Switzerland.—In Switzerland the question has been agitated for some time as to the best method to use for changing over the Federal railroads to electric traction, and a commission was appointed to look into the matter The commission recently issued its report and in this it concludes in favor of electric locomotives running on the single-phase system with 15,000 volts on the overhead wire Direct current is not favored, even though it takes less power, on account of the drawbacks it presents, first cost among others It is estimated that the expense of transforming all the Federal lines will reach $15,000,000, but there will be 10 per cent economy realized in operating the railroads The Swiss government has already allotted credits for purchasing a number of falls so as to erect electric plants for supplying the current

Electric Railroad from Genoa to Busalla.—A successful electric railroad is now running in the north of Italy from Genoa to Busalla, under control of the government. Genoa sends coal to all the northern region including Milan and Turin. A steam railroad ran across the mountains for this purpose, but the new electric road will be much superior It has heavy gradients and numerous tunnels, and uses heavy electric locomotives designed after the Simplon and Vaitellina types. Current is taken from a 3,000-volt line, working on the three-phase system The locomotives are designed to draw a 400-ton train upon 3.5 per cent grades at 25 miles an hour, and have 65 tons adhesion weight. The four axles of the locomotives are coupled by bar and crank and are driven from two 750 horse-power motors.

Science

Prehistoric Nursing Bottles.—According to recent discoveries it appears that nursing bottles were used even in prehistoric times This is true at least for the age of polished stone, inasmuch as a French archæologist, M Nicaise, when exploring a neolithic funerary deposit, found a small clay nursing bottle, and this was quite intact This is not the only specimen of the kind which comes from early ages Among others are the specimens found in the Gaulish burial places of Jonchery and more recently in the Gallo-Roman arena of Paris This latter, it will be remembered, was uncovered within a comparatively late period

The Genetic Congress.—The Fourth International Genetic Congress, recently held at Paris, was occupied mainly with the crossing of breeds in plants and the resulting hybrids which are obtained Outside of the great scientific interest which is involved, the question has a very practical bearing For instance M Soloman made experiments upon the crossing of potatoes for six years past, and hopes to produce a variety which will be able to resist the rotting disease The question of hybrids in connection with many kinds of plants such as peas, tobacco, cloves and others formed the object of the papers read at the congress

A New Comet.—A cablegram has been received at Harvard College Observatory from Prof Kobold at Kiel, stating that a comet was discovered by Schaumasse giving the following position

1911 Nov 30 6491 Greenwich Mean Time, R A 13h 12m 12s Dec +5 deg 51m

Daily motion R A 3m 32s, Dec —13m

The comet is visible in a small telescope A late cablegram from Kiel states that Schaumasse's comet was observed by Brashrock at Ucle in the following position

1911 Dec 4 7482 Greenwich Mean Time, R A 13h 26m 25.78 Dec 4 4 deg 57m, 05s

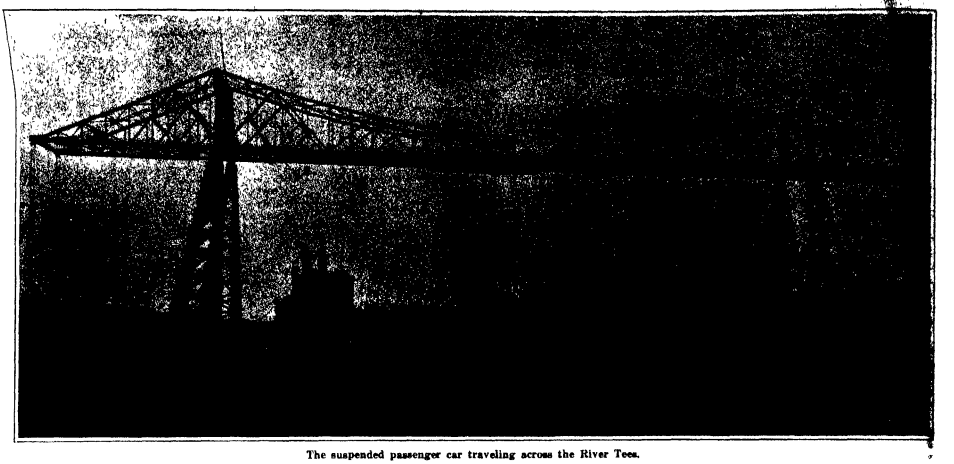
Sterilized Post Holes.—An engineer in Budapest has invented a process for the preservation of wood which bids fair to be of much economic importance The process is intended to be applied to wood used in outdoor construction, such as railroad ties, telegraph poles fences, palisades, and the like It consists in a sterilization of the surrounding soil by means of a liquid poured into the hole in the earth before the post or tie is planted The liquid is composed of chemicals which effectually destroy all insect life and all cryptogamous vegetation in the surrounding earth According to *La Revue* this prevents the rotting of the wood without the necessity of treating it with creosote, so that both time and expense is saved in many cases

Conversing With Animals.—A certain Charles Kellogg, of California, has appeared at Cambridge with the object of convincing the Harvard faculty of his ability to talk with animals His life has been spent among the Sierra Nevadas, and his studies include the vocal sounds made by bears, squirrels, lizards, rattlesnakes and crickets Indeed, he claims proficiency in fifteen animal languages He has a peculiar palate with no tonsils, and entirely lacks the cord connecting the teeth with the lips To these peculiarities he partly ascribes the ease with which he imitates the sounds of insects and animals Some of his observations and ideas are at least interesting, if not convincing

Excavations at Delphi.—The French School of Athens has been making some interesting excavations at Delphi, bearing upon four main points, the Temple of Hera, the valley and basin of the Ispous, the gymnasium and the theater quarter More than 200 vases were found in the basement of the Temple, dating from the 7th to the 6th century B C Some blue ware of an unusual kind was found here, also a fine series of terra cotta busts of the goddess Hera The plan of the gymnasium is now recognized, and some good stone inscriptions come from this spot To the west of the basin which collects the water of the Ispous torrent are the ruins of a small sanctuary which appear to date from the early history of Delphi

The Weight of Various Brains.—While the weight of the individual brain in each particular species, as compared with that of the entire system, may be said to have some bearing on the intelligence of the individual, there is no fixed proportion between the weight of the brain and the total weight of the body as between one species and another, as is shown by the following table

	Grammes	Average Ounces	Proportion	Per Cent
Elephant	4,660	16 44	1/459	0 23
Whale	2,490	8 78	1/25000	0 04
Man	1,400	4 94	1 42	2 38
Horse	500	1 76	1/534	0 19
Gorilla	425	1 50	1/213	0 47
Orang outang	400	1 41	1/134	0 75
Sheep	133	0 47	1/377	0 27
Dog	105	0.37	1/200	0 50
Pigeon			1/150	0.67



The suspended passenger car traveling across the River Tees.

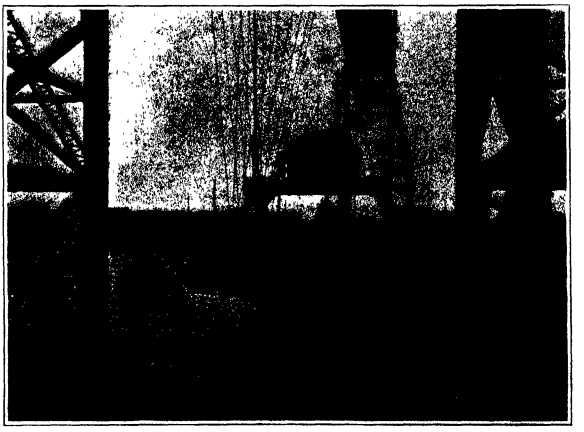
Novel Transportation Bridge in Great Britain

A Suspended Ferry

By F. C. Coleman

A NEW transporter bridge, which has been under construction for the past three years over the River Tees, one of the great industrial waterways of North-Eastern England, was formally opened for traffic by H R H Prince Arthur of Connaught on October 17th Hitherto communication between the thriving town of Middlesbrough and the industrial area on the north side of the river has been maintained by means of a municipal ferryboat service, but, during recent years, this method of transport has proved both inadequate and inconvenient Consideration has been given at various times to projects for a tunnel under the river, a suspension bridge, an ordinary swing bridge and also a rolling lift bridge In the case of a busy river like the Tees it is essential that any means adopted for accommodating the cross traffic should interfere as little as possible with the conduct of the up-and-down stream traffic and if no other objections existed there would be no doubt but that a tunnel or high level bridge would have afforded the best means for attaining this end But both the tunnel and the high level bridge, independently of high cost, would have involved the difficulties of approaches and in the case of a high-level bridge, this would, in a flat district like that of Middlesbrough, form a practically insurmountable obstacle, so long as the bridge was utilized by the traffic passing over it in the ordinary way Accordingly, in 1906, the Middlesbrough Corporation decided to replace the ferries by a transporter bridge

The Tees transporter bridge consists of two groups of piers erected on either bank of the river on masonry foundations and connected by a pair of lattice-type girders of 570 feet span with depths varying from 65 feet over the towers to 21 feet at the centers The underside of these girders is 160 feet above high water mark The girders on the lower flange each carry two lines of rails and are placed at a distance of 35 feet from center to center On the four lines of rails there is supported a traveling platform from which a traveling car, 44 feet by 39 feet, is suspended This car is provided with passenger cabins on each side, and its floor is level with the roadway on each side



Passenger car approaching the Middlesbrough side.

of the river Accommodation will be found for about 600 passengers and six road vehicles As the upper platform travels across the high-level girders the car is carried across the river between the landing places, the hauling to and fro of the traveling platform being effected by an endless ropeway The ends of this rope are fixed on a winch placed on the south side of the river and driven by two 60 H P. Westinghouse motors The journey from shore to shore will be accomplished in less than two minutes The working of the car will, generally be controlled from the pilot house placed on the top of the passenger cabin on the suspended platform, but in case of emergency it can also be worked from the winch house, distant about 150 feet from the main tower of the bridge on the Middlesbrough side of the river. One motor will, it is anticipated, be more than sufficient to propel the car, even in the most severe gale

The main girders are of the braced cantilever type and the extremities of the main span are anchored and secured to concrete anchorage blocks on each bank of the river by 16 wire ropes embedded in concrete, each rope being capable of withstanding a breaking strain of 300 tons. Owing to the unfavorable strata the main towers on the Port Clarence side have been distanced 130 feet from the shore and approach is therefore made by a lattice girder bridge. On the Port Clarence side the foundations were carried down to 90 feet below high water of spring tide, and on the Middlesbrough side to a depth of 70 feet. The caisson foundations are filled up solidly with concrete, and 10,000 cubic yards of concrete were used in these foundations and in the retaining walls supporting the same. After the caissons had been sunk and the steel towers sunk, the erection of the main girders proceeded simultaneously toward the land arm and over the river on the cantilever system. As the steel arms from each side of the river approached one another careful measurements as to levels and line had to be taken from time to time so as to insure an exact meeting in the center. As soon as they were within 100 feet of one another, exact dimensions were taken and after due allowance had been made for the proper measurements the closing lengths of the steel work that were required to fill in the gap were completed at the contractors' works and forwarded to the site. Aided by favorable weather conditions, the 100 feet of closing lengths was erected in position in sixteen hours, the work coming together perfectly as to line and level. The temperature at the time of closing was 58 deg. Fahr. The height of the towers above high water is about 250 feet, so that the bulk of this work was carried out at a height of about 200 feet.

[illegible]al stairways on one [illegible] two towers of each [illegible]ent afford access to the main platform of the bridge and this passageway is specially illustrated in one of the photographs. The total length of the bridge and approach span is 850 feet, the length of each cantilever girder overhanging on the landward side of the towers is 150 feet, and the extreme height of the bridge above high water to the top of the center of the towers (i. e., to the top of the main posts of the cantilever girders) is 325 feet The base girders, on which the towers are built, have a length of 98 feet, a depth of 16 feet, and a weight of 1163 tons. The total amount of steelwork in the bridge is 2,600 tons and there are 600 tons of steelwork in the caisson foundations. The total cost of the works and approaches, including buildings and all auxiliary work in connection with the structure, is estimated to be about $408,660



The boulevard across the main girder of the bridge, reached by spiral stairways in the towers.

The Rabbit Problem in Australia

RABBITS are well known to be the curse of Australia, notwithstanding the fact that, according to the view of the commonwealth meteorologist, Mr H A Hunt, the burrows of these animals, by keeping the ground broken up make it more retentive of rainfall -a philosophical consideration that strongly suggests Mark Tapley Latterly, the Australians have been trying with considerable success to turn their curse into a blessing by marketing their surplus rabbits (dressed) in European countries

The Most Powerful European Express Engine

An Important French Locomotive Development

THE Chemin de Fer du Nord has recently introduced into service, huge "Baltic" type, four-cylinder compound superheater locomotives for operating the Nord Express, connecting Paris with Brussels, Berlin, the Baltic seaboard and St Peteraburg This international express service ranks as the fastest train service in the world, and, with 400 tons coach load, the French engine attains 75 miles per hour, developing in the cylinders about 2,000 horse-power.

Two engines of the "Baltic" wheel arrangement have been built by the Chemin de Fer du Nord for comparative working, the only difference being that the first engine, 3.1101, is fitted with ordinary locomotive firebox and boiler, while the later engine, 3.1102, has a marine pattern water-tube firebox. This firebox was designed by the Nord company's engineers, although actually constructed at the Creusot Works of the Schneider Company Both engines are fitted with apparatus for highly-superheated steam, and the cylinders in each engine are identical Instead of constructing the ordinary type boiler for saturated steam and placing a water-tube boiler for superheated steam over a simple engine, the same system of compounding is here employed in both engines

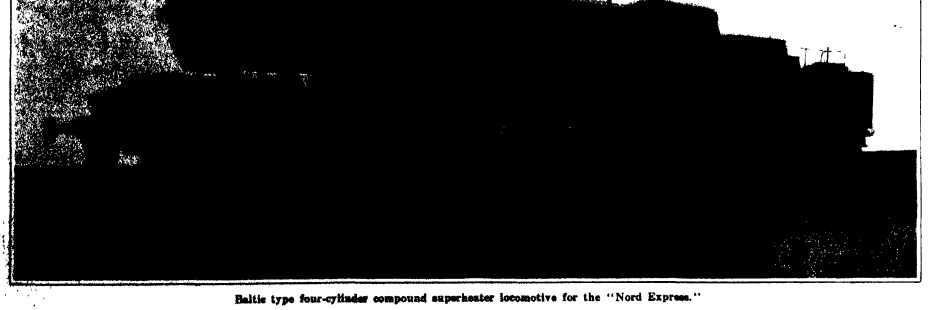
The previous largest engines in Europe are the "Pacific" type, class 10, of the Belgian State Railways, which have four cylinders, each 500 millimeters by 660 millimeters (19 68 x 25 98 inches) The new Nord engines have, however, two high-pressure cylinders, 440 millimeters (17.32 inches) by 640 millimeters (25 19 inches) and two low-pressure cylinders 620 millimeters (24 41 inches) by 730 millimeters (28 74 inches) Further, while the steam pressure in the Belgian engines is 200 pounds per square inch, the French engines carry a pressure of 227 5 pounds per square inch with direct admission from the boiler to all the cylinders whenever it is found desirable for starting

These French engines, although very much more powerful in starting effort than the Belgian locomotives, are of the same weight, loaded and empty, as the latter, but the boilers of the Nord engines have 23 per cent more heating surface

The chief interest in these new locomotives is the novel solution of the cylinder problem which has, for years past, been an obstacle in the design of very powerful locomotives, the difficulty occurring when specially large cylinders are necessary, either for low-pressure saturated steam, superheated steam, or extra low pressures in one-half of a compound engine The high-pressure cylinders are mounted outside the frames and drive on the center pair of the three sets of coupled wheels with cranks set at 90 degrees apart The low-pressure cylinders are inside the frames and drive on the forward pair of coupled cylinders The cranks in this case are also set at right angles to one another and each high-pressure is at 180 degrees from its corresponding low-pressure crank One of the low-pressure cylinders is set in advance of the other so as to get the centers of the piston rods close together Although intended for cylinders working at 80 pounds maximum pressure, this device is applicable to any system of engine with such modification as may be desirable The driving wheels have a diameter of 6 feet 8⅛ inches and the bogie wheels a diameter of 3 feet 4½ inches The firebox grate is 8 56 feet in length and 5 3 feet in width and the grate area is 46 square feet The total heating surface amounts to 4 294 93 square feet to which the water tubes and firebox contribute 1,097 95 square feet and the smoke tubes 2,629 6 square feet while the superheater surface is 667 38 square feet The boiler barrel has a diameter of 6 feet 2¾ inches The water capacity is 1,886 gallons, and the steam capacity 690 8 gallons The tractive force of these locomotives working compound, is 32,429 pounds, and simple 42 834 pounds

An interesting innovation is the adoption of mechanical stokers On the Northern Railway the express engines are served with "smalls" and tout-venant' which, to avoid choking the fire and evolving heavy smoke, must be laid on thinly and with great frequency Opening the fire-door frequently is injurious to the tube plate and tends to lower the temperature of the steam in the superheating pipes With mechanical stokers these and other objections disappear the fuel in fine powdery form may be blown into the fire box with suitable tuyères

In running order the engine weighs 102 tons, of which 24 tons is on the leading bogie, 54 tons on the coupled wheels and 24 tons on the trailing bogie The tender is of the standard Nord 8 wheels type and weighs 56½ tons, so that in working order these "Baltic" locomotives have a total weight on rails of 158½ tons



Baltic type four-cylinder compound superheater locomotive for the "Nord Express."

Some Locomotive Curiosities

Showing How Present Practice Was Reached by Trial and Error

By Herbert T. Walker

IT is only within recent years that the locomotive has been studied by scientific men on systematic principles, with the aid of elaborate testing plants and other special apparatus

The early designers of locomotives were not scientific men in the strict sense of the term They were mechanics who studied science in their leisure moments, and were not always well grounded in principles. They were, moreover, hampered with ideas of stationary engine practice, for the earliest locomotives were but little more than stationary engines on wheels Even the rails were laid on stone blocks after the manner of stationary engine foundations

Thus, the attempt to adapt a low speed stationary engine to a fast locomotive produced many curious and interesting examples

Drawings of many of these are in the writer's possession, and engravings of ten of them are here presented with a brief description

A fruitful source of trouble to the old locomotive designers was a tendency to follow the teachings of James Watt, who had laid down a fixed rule that the piston speed of a steam engine should not exceed 220 feet per minute The only way, then, to build a high-speed locomotive was to employ large driving wheels The culmination of this theory is found in engines built for the Great Western Railway (England) which originally had a track gage of 7 feet The engineer of this railroad was I K Brunel, who, although he was the greatest civil engineer who ever lived, fell into the same error as his contemporaries He wanted the fastest locomotives in the world, and when ordering them of various builders he limited the piston velocity with the result that when the railroad was opened for traffic (June 11th, 1838) the motive power superintendent, Daniel Gooch, was confronted by a collection of engines which made the roundhouse look more like a museum of curiosities than anything else

Two of the engines are illustrated herewith Fig 9 shows the "Ajax," the driving wheels of which were 10 feet in diameter Cylinders 14 inches diameter by 20 inches stroke Total heating surface, 474 square feet The wheels were built up of boiler plates A drawing of this engine was first published in the *Locomotive Magazine* (London) of 1901 by Mr G F Bird in his "History of the Great Western Railway Locomotives," and by the courtesy of the editors of that journal a reproduction is here given

The other 10-foot driver engine was a fearful and wonderful machine, for the engine and boiler were on separate frames, as shown in Fig 2 The object of this arrangement was to distribute the weight, as the rails of that period were very light The engine had a tender (not shown) behind the boiler where the fireman attended to his duties, but the engine driver was stationed on a platform forward of the driving axle, without any shelter from the weather The cylinders of this monstrosity were 16 inches diameter by 26 inches stroke Total heating surface, 623 42 square feet The weight of the engine carriage was 13 tons, of which only about 6 tons were available for adhesion, so that with the absurdly small cylinders the engine was almost useless for practical work, although it would go fast enough with a light train In fact it was reported that both this engine and the "Ajax" attained a speed of 100 miles an hour when running without a train, but this is very doubtful

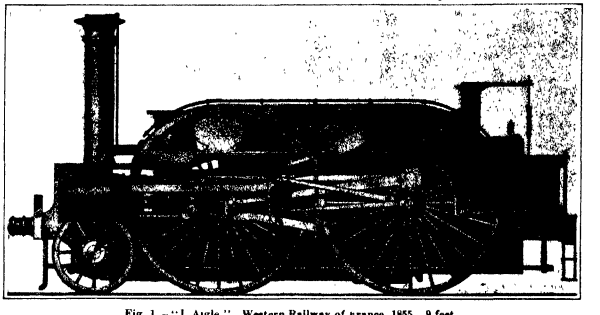


Fig. 1.—"L Aigle." Western Railway of France, 1855. 9 feet 4 inches coupled wheels. Boiler below the driving axles.

Other and more practical engines were built with large wheels as for example the "Cornwall," designed by Francis Trevithick in 1847 This engine is illustrated in Fig 4 It did good service on the London and North-Western Railway The boiler was slung below the driving axle, as a high boiler was considered unsafe for fast running The "Cornwall" was like a rare animal and attracted much attention, as it was considerably lower than the cars of its train The driving wheels were 8 feet 6 inches in diameter Cylinders 17½ inches diameter by 24 inches stroke Total heating surface, 1,046 square feet Weight, 30 tons A speed of 117 miles an hour was claimed for this engine but this is not credited by engineers Under official tests it attained a speed of 79 miles an hour with a light train Full particulars of this engine were published in the SCIENTIFIC AMERICAN of June 10th, 1905

The "Lightning," an American engine with large drivers, is shown in Fig. 3 This engine was of the "Crampton" type, the driving wheels being placed behind the fire-box. It was built at the Norris locomotive works in 1849 for the Utica and Schenectady Railroad The cylinders were 16 inches in diameter by 22 inches stroke. Driving wheel 7 feet in diameter As the heating surface of the boiler amounted to only 678 square feet, it was a poor steamer. Nevertheless it attained a speed of 72 miles an hour for a short distance with a light train. The engine weighed about 20 tons and was in service a little over one year

The last example of a large wheel engine is shown in Fig. 1. It had the largest coupled wheels ever used, namely, 9 feet 4 inches. It was designed by Blavier and Larpent for the Western Railway of France in 1855, and was exhibited at the Paris Exhibition of that year. The name of this engine was "l'Aigle." The cylinders were 16½ inches in diameter by 31½ inches stroke The boiler was below the driving axles as in the "Cornwall," but was so short of heating surface that the engine never did any useful work. To show that nothing is gained by excessively large wheels, we may point out that an engine with cylinders of the same diameter as that of "l'Aigle" and a stroke of 22 inches, with 6½ feet driving wheels would have given the same tractive effort with the same mean pressure of steam; and with this observation we may dismiss the subject of large driving wheels.

There was a still more interesting class of early engines which were called "compensated locomotives" They were the earliest balanced engines, and show some original attempts to overcome the erratic movements of a locomotive when traveling at speed without driving wheel counterweights The oldest of these engines is shown in Fig 10 It was built in 1833, and worked on a short road running between Bolton and Kenyon Junction, now forming part of the London and North-Western Railway No dimensions of the engine are available, but the driving wheels scale a diameter of 5 feet The equilibration of the reciprocating masses can be easily understood, for the oppositely moving parts connected to the vibrating arm or "side lever" partially balanced each other, although with the vertical boiler and high pitched cylinders the engine was probably an unsteady rider, if it ever went fast—which is doubtful.

The most important side lever locomotive ever built is illustrated in Fig 7. It was designed by the celebrated Crampton in 1847 and patented by him. The driving wheels were 6 feet in diameter Cylinders 16 inches in diameter by 20 inches stroke. Weight



Fig. 2.—The "Hurricane." Great Western Railway, 1838. 10-foot driving wheels. Boiler and engine on separate frames.

Total heating surface 1,371 square feet. This engine was named "Lablache," after a noted operatic singer of the day. Details of its performance cannot be given here, but we may note that the engine was officially timed at 79 miles an hour with a light train.

On one occasion the "Lablache" hauled a freight train of 430 long tons at an average speed of 30 miles an hour, which was no mean performance at that period. The peculiarity of this engine was that the cylinders inside the frames actuated vibrating arms connected to the outside levers called the "side levers." These side levers were coupled to the cranks in such a way that when the front driving wheel crank was, for example, on the back center, the rear crank was on the front center, and thus the stresses of these oppositely moving parts were balanced. Moreover, the cylinders, guides and vibrating beam fulcrums were all bolted rigidly to the frame and therefore not subject to the effects of crosshead vertical thrust, as in the ordinary locomotive. The "Lablache" was tried on the Midland and other railways in England, but no company would purchase it on account of its great weight, and it was in use only a short time.

Another curious locomotive was built in 1856 in which the "Lablache" arrangement of cranks was repeated, but the cylinders had double pistons and a separate rod for each crank. This design was patented in England by Charles Ritchie in 1848, but he did not build an engine until eight years later. This engine is shown in Fig. 5. As the two pistons in each cylinder always moved in opposite directions the fore and aft stresses set up by the reciprocating parts were neutralized, for the momentum of one piston and its connections was balanced by that of the other. This engine weighed about 25 tons. The wheels were 6 feet in diameter. Cylinders 12 inches diameter by 36 inches stroke, each piston having a stroke of 18 inches. Supposing the engine to be in the position shown in the drawing and steam admitted to the center of the cylinder, the pistons would be driven apart and the engine would travel forward. As coupling rods could not be used Ritchie designed a parallel motion, the two sets of which

(Continued on page 568.)

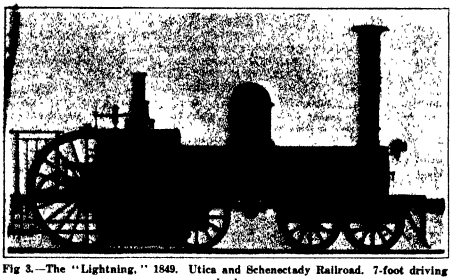


Fig. 3.—The "Lightning," 1849. Utica and Schenectady Railroad. 7-foot driving wheels.

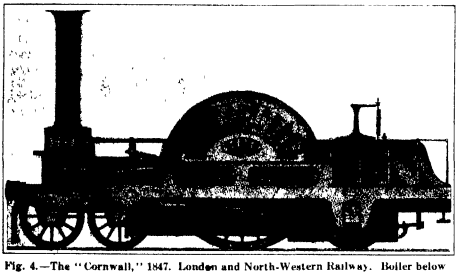


Fig. 4.—The "Cornwall," 1847. London and North-Western Railway. Boiler below the driving axle.

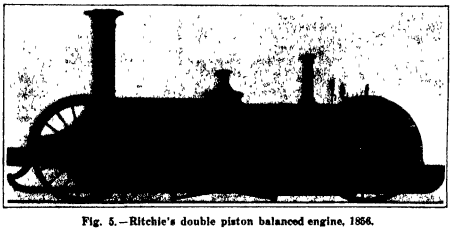


Fig. 5.—Ritchie's double piston balanced engine, 1856.

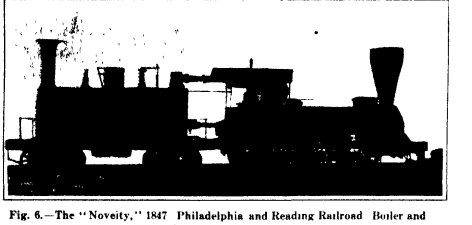


Fig. 6.—The "Noveity," 1847. Philadelphia and Reading Railroad. Boiler and engine on separate frames.

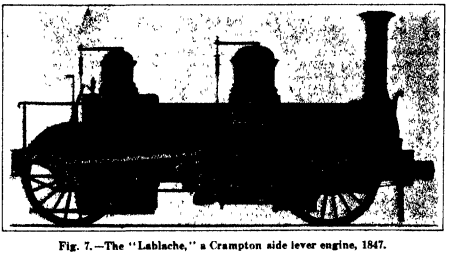


Fig. 7.—The "Lablache," a Crampton side lever engine, 1847.

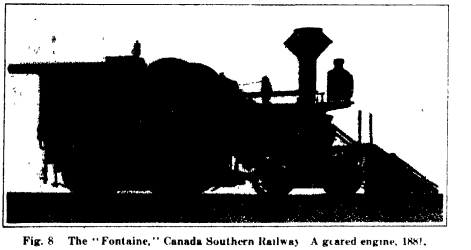


Fig. 8. The "Fontaine," Canada Southern Railway. A geared engine, 1881.

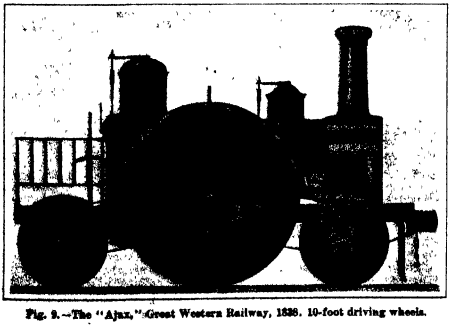


Fig. 9.—The "Ajax," Great Western Railway, 1838. 10-foot driving wheels.

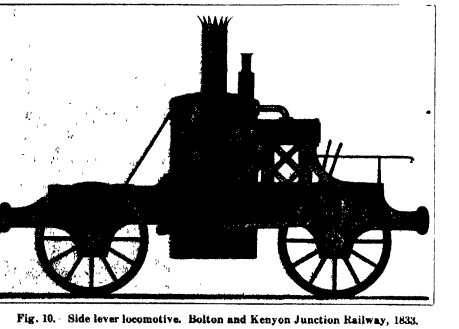


Fig. 10. Side lever locomotive. Bolton and Kenyon Junction Railway, 1833.

SOME LOCOMOTIVE CURIOSITIES

The Laboratory

Some Suggestions for Home Experiment

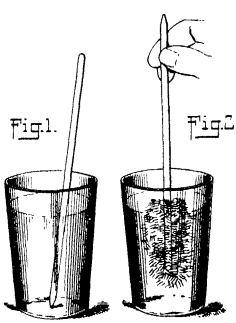
Experiments in Crystallization

By A. J. Jarman

DURING the process of crystallization of many chemical salts, some unusually peculiar phenomena occur It is well known that if a saturated or supersaturated solution of almost any salt is allowed to stand undisturbed for some time, many hours and sometimes days will elapse before crystallization will commence While if the vessel is disturbed, or the liquid stirred crystallization will start immediately and the heat that was absorbed in producing liquification, will be given out during crystallization A very good example of this was described in the issue of November 4th, under the heading "A Heat-Storing Water Bag" When hyposulphite of soda is dissolved in water at ordinary temperature a considerable quantity of heat is absorbed as the following experiment will show The temperature of the surrounding air was 70 deg Fahr Ten fluid ounces of water was taken and placed in a clean wide-mouth bottle, the temperature of the water being 60 deg Fahr Twelve ounces of *granulated* hyposulphite of soda was added to the water, and stirred with a glass rod until nearly dissolved. Upon inserting the thermometer the temperature fell from 60 to 30 deg Fahr and in the course of about one minute the temperature had fallen to 29 degrees

This experiment fully indicates the reason why in photography warm water must be used in the winter time in mixing the fixing solution, either for paper prints or plates, otherwise the time for fixing would be prolonged for a considerable period, and cause patchiness, in color, as well as an irregular fixed print.

Another interesting experiment is as follows Prepare a supersaturated solution of sulphate of soda



Crystallization started with unsterilized glass rod.

(this usually requires two ounces of the salt to one ounce of water) Heat two or three small glass tumblers and pour the supersaturated solution into each Cover the top of each vessel with a piece of sheet glass, and let the tumblers stand undisturbed until they have become quite cold It is well to prepare the vessels at night, allowing them to stand undisturbed until the morning They will then be ready for the next step in the experiment Take a glass rod, about 9 or 10 inches long and a quarter inch diameter Make one end red hot for about two inches, in either a spirit lamp flame or a Bunsen burner Suspend it to cool, and then stick a piece of gummed paper about five inches from the end that was heated, in order to identify it

As soon as the rod is quite cold, remove one of the glass plates from the vessel containing the cold solution of sulphate of soda, insert the end that has been heated, and stir the liquid No crystallization will take place

Turn the rod around, insert the end that has not been heated and stir the liquid Crystallization will begin at once, and will continue until the liquified salt has become a solid mass

The experiment can be repeated with the second or third vessel with the same result, providing the salt has not crystallized upon the end that was originally made red hot If crystallization has taken place, the end must be well washed by pouring warm water over it This peculiar property has been known in some instances to be retained by the glass rod for two weeks, when not touched, and kept from the atmosphere The experiment is not a costly one. Hyposulphite of soda can be purchased at almost any drug store for five cents a pound, and sulphate of soda at about the same price. The illustration in Fig. 1 shows the stirring without causing crystallizing; Fig. 2 shows the growth of crystals from the rod in the center of the saline solution.

Preparation of Small Quantities of Impure Radium Bromide

By James H. Doran

THE idea is undoubtedly held among most amateur chemists and physicists that experiments with radium are inaccessible to those who have only a limited fund for experimenting in this line However, those who have a fair chemical equipment can prepare samples of fairly active material with little trouble and with which a great many interesting experiments can be performed The radium in these samples is of course infinitesimal, but asserts its presence by ionising gases and discharging electroscopes, and by blackening photographic plates through paper and sheets of wood and thin metal

In the separation of active material from pitchblende, samples of the ore which are known to be high in uranium should be taken as these always yield the most active substances The ore is first reduced to a powder and roasted in a crucible for about 45 minutes and after cooling, pulverized to a fine powder It is then mixed with about twice its weight of sodium carbonate and a little sodium nitrate and the mixture is again heated for nearly an hour. It is then extracted with water, and filtered and washed until all soluble parts are washed away The insoluble portion is treated with a mixture of three parts C P sulphuric acid and one part C. P. nitric acid and this diluted with an equal amount of water. The acid should be added until effervescence ceases and until no more ore apparently goes into solution. The solution is then allowed to stand with occasional stirring for at least 24 hours The insoluble part is allowed to settle and the acid solution decanted If desired, this solution may be used for separation of the uranium contained in it After decanting, the residue is thoroughly washed and treated in the same manner with an equal mixture of C P hydrochloric acid and water This mixture which contains the polonium and actinium is then decanted and the residue washed and boiled with a saturated solution of sodium carbonate so as to change the still insoluble sulphates into carbonates The sodium carbonate solution is drawn off and the residue washed and digested with pure hydrochloric acid diluted with a little water This solution contains the active material which has now gone into solution It is filtered and a slight excess of ammonia is added to the filtrate Then it is again filtered and hydrogen sulphide gas is led into the clear solution until no more precipitation occurs After filtering, sodium carbonate is added to the filtrate and the precipitate thus formed is thoroughly washed Several grains of this mixture of active carbonates should be obtained from each ounce of ore

Enough dilute hydrobromic acid is added to dissolve the carbonates and the solution is filtered C. P. sulphuric acid is added until the precipitation is complete when the precipitate is washed by decanting until all of the calcium sulphate in the sample is dissolved or until only a few grains remain (the quantity of barium sulphate being often very small if only three or four ounces of ore are used) This residue is converted into carbonates by boiling with sodium carbonate solution and this again is converted into bromides by a slight excess of C. P hydrobromic acid. The solution is evaporated to dryness and is quickly transferred to glass stoppered bottles or is sealed into tubes. In this way a centigram or two of the radiferous calcium and barium bromides may be obtained from a pound of ore. However, if the quantity is very large and it is desired to obtain more active material this may be done by a series of crystallizations and recrystallizations until the desired activity is reached. The radium bromide is less soluble than the barium salt, hence it crystallizes more quickly.

The radiferous calcium and barium bromides obtained in this way are often self-luminous, the color of the phosphorescence varying with activity. The samples lose their phosphorescence if allowed to accumulate moisture but recover it again on being dried.

If the samples are very active they will produce fluorescence in barium platinum cyanide and [illegible] the scintillations of the a rays when held close [illegible] zinc sulphide screen and observed through a ma[illegible]fying glass. Good radiographs can be taken in a [illegible] hours' time with a few grains of the impure Ra[illegible] prepared in this manner, X-ray plates being the [illegible] to use for this purpose.

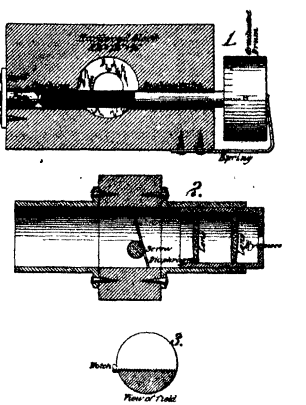
A Simple Micrometer

By Claude C. Kiplinger

THE instrument here described has been in use [illegible] some time on a home-made spectrometer and [illegible] given good satisfaction Although it is not intended to replace a first class filar micrometer, its simple construction renders it a desirable piece of apparatus

As in nearly all devices of this sort, the most important part is the screw. A metal rod, preferably of brass, 2½ inches long and three-sixteenths inch in diameter is threaded at one end for two inches of its length with either fifty or one hundred threads to the inch, according to the sensitiveness desired A metal drum, with its perimeter divided into twenty equal parts by a scale, is soldered to the unthreaded end of the rod, as shown in Fig. 1. This completes the moveable part of the apparatus.

A block of hard wood should be squared up to the dimensions shown in the sketch. A three-quarter-inch



A micrometer of simple type.

hole is bored through the flat side of the block, at its middle point, and a four-sixteenth-inch hole is drilled from end to end intersecting the former, as illustrated. The latter hole should be bushed at each end with brass tubes, in which the threaded rod turns easily, but without play A metal plate covers one end of the hole and a closely fitting steel pin is inserted, of such a length that the threaded rod having been introduced, the drum will be stopped about one-fourth of an inch from the end of the block. A spring presses on the drum and holds the screw firmly against the pin.

A sheet metal diaphragm with a three-eighths inch aperture is fitted in a slanting position, shown in Fig. 2, so that its upper part will fall into the same focal plane as the top of the screw. A notch is cut at one side of the aperture to serve as a reference point (see Fig. 3). Brass lens tubes are attached by means of flanges and wood screws. The inside of the tubes and the diaphragm should be blackened. A positive eye-piece of one-inch focus is used. However, a single convex lens of the same focus may be substituted.

After assembling the instrument, the eye-piece should be focused sharply on the top of the screw. The field will now appear traversed by a series of notches, as in Fig. 3. When the drum is turned through a complete rotation, each notch is made to shift its position by its own width. Hence, fractional parts of a notch will be indicated by the drum divisions. There is obviously no lost motion and if the threads are accurately and sharply cut very precise measurements may be made. This micrometer may also be used with a microscope.

The Inventor's Department

Simple Patent Law; Patent Office News; Inventions New and Interesting

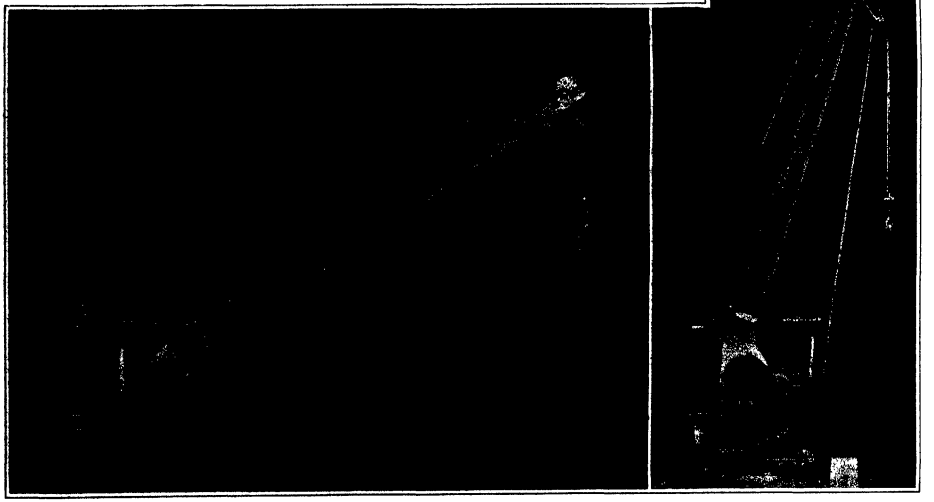
Compensating Quadrant Crane

THERE is a certain type of machine now in common use that has been handed down to us, with little change, from the very earliest days of history. The crane as employed by the Egyptians in building the Pyramids was not radically different from the derrick of the present day. It consisted then, as it does now, essentially of an upright mast with a boom or gaff. Practically the only advances made in this type of machinery have been in the manipulation of the crane or the motive power utilized. Recently, a patent has been granted on a crane which is a decided innovation. The crane has no mast, but consists merely of a beam mounted on a frame in such a way that it can swing forward like the boom of a derrick while the load it carries moves on a virtually horizontal line as the beam is raised to the vertical position.

The beam is built up of rolled steel and is secured to a pair of quadrants of cast steel formed with teeth, to engage racks at the foot of the frame. The frame is mounted on a swivel base. The beam is raised or lowered by means of a horizontal screw which passes through a nut journaled to the quadrants. As the screw is operated, the quadrants roll on the toothed foot of the frame. Hence, the fulcrum, which is the point of contact of the quadrant with the frame, moves outward as the beam moves toward the horizontal and at the same time the length of the lever from load to fulcrum is reduced, owing to the bell-crank form of the beam and quadrants.

The compensating mechanism consists of a pair of arms hinged to the beam near the upper end, and secured to one end of a cable, which passes over a sheave at the top of the beam, and then runs to a point on the frame where it is permanently secured. As the beam is moved backward or forward, the arms are correspondingly swung on their hinges, so that their outer ends trace a practically horizontal line. At these outer ends the arms support the upper blocks of the hoisting tackle over which the hoisting cables run to a pair of winding drums. As a result of this "parallel motion" the load is not materially lifted as the crane is swung upward, and the bending moment on the beam is greatly reduced.

The accompanying illustrations show a model of a full-sized 4-ton crane, which has a lifting capacity of 2½ tons. In this crane the actual reduction in bending moment of the beam due to the compensating device is five-sixths; that is, a load of 120 foot-tons is reduced to 20 foot-tons, while the maximum thrust on the screw is less than 2¼ tons. The screw may thus be regarded as a simple controlling device rather than a means for shifting the load, the load being practically balanced. There is no bending moment on the screw, the thrust being exerted in line with its axis. In use the crane is provided with separate motors for actuating the screw and the winding drums, and the gear by which the crane is swiveled on its base. Thus the crane is self-contained, making it a very serviceable piece of machinery for docks, ships, wrecking cars, etc. It is the present practice in the construction of buildings to operate the cranes from a plant on the ground floor. Greater facility of operation would be afforded by the use of self-contained cranes, particularly in tall buildings.



Novel crane with traveling fulcrum and compensating device for moving the load on a horizontal line as the crane beam is raised.

Another Confederate Patent

IN the SCIENTIFIC AMERICAN of November 4th appeared a reproduction and account of a Confederate Patent No. 13. We have just examined a reproduction of another Confederate patent, which except as to names, number, title, date and signatures is like that already published, so its reproduction would not be interesting. This other patent is No. 149, issued February 18th, 1863, to D. W. Hughes of Arizona, and disclosed an improvement in breech plugs. An illustration accompanied the patent, in style and execution quite similar to the patent drawings of to-day. The patent describes a removable plug of a breach loading cannon, the plug having radially projecting lugs which turn into interlocking engagement with seats in the bore of the gun. The patentee, D. W. Hughes, is still living at the age of 83 at 437 North 3rd St., Hamilton, Ohio. Mr. Hughes' patent, like the earlier patent No. 13, above referred to, is signed by Rufus R. Rhodes as Commissioner of Patents. Mr. Rhodes was a former official of the United States Patent Office, having been appointed an assignment examiner on June 20th, 1857, and promoted to principal examiner in July, 1858. He resigned February 15th, 1861. The patent No. 13 was issued August 23rd, 1861, just a little more than six months after Mr. Rhodes left the United States Patent Office.

A New Patent Office Ruling on Perpetual Motion Machines

ALTHOUGH it might be supposed that the absurdity of perpetual motion had been completely exploded long ere this, every patent lawyer can cite numerous cases to show that even in this twentieth century of alleged scientific enlightenment many a deluded inventor is still trying to get a mechanical something out of nothing. To the credit of the patent profession at large be it said that the inventor is usually told that he is wasting his time and his money. It is frequently difficult, however, to convince an inventor that his schemes are impracticable, so that many an attorney, much against his will, is compelled to prepare specifications and claims which relate to an invention that is inoperative.

In the past it has been the practice of the Patent Office to demand a working model from the inventor of perpetual motion machines. The man who can not be convinced by an attorney that his machine is inoperative is not likely to be discouraged by any such requirement. The result is that many an inventor spends hundreds and perhaps thousands of hard-earned dollars in trying to build an operative perpetual motion model—a task which any one with an elementary knowledge of mechanics can tell him is hopeless.

To meet this peculiar situation the Patent Office has now made a ruling which must commend itself to every member of the patent bar, as well as to those engineers and inventors who come into frequent contact with the Patent Office Examiners. The Commissioner, in order to spare the inventor the necessity of parting with at least the government fees for an application, which must inevitably be rejected, has decided that hereafter no application for a patent on a perpetual motion machine will be considered at all unless a working model is filed in the very first place.

The exact wording of the Commissioner's ruling is as follows:

"The views of the Patent Office are in accord with those of the scientists who have investigated this subject and are to the effect that such devices are physical impossibilities. The position of the Office can be asserted only by the exhibition of a working model. Were the application to be forwarded to the Examiner for consideration, he would make no examination as to the merits, but his first action would be the requirement that a working model be filed.

"In view of all circumstances, the Commissioner has instructed that applications for patent on Perpetual Motion, complete in all other particulars, shall be held in the Application Rooms as incomplete until a working model has been filed. Such model must be filed within one year from the date of application, or the application will become abandoned. The Office hesitates to accept the filing fees from applicants who believe they have discovered Perpetual Motion, and deems it only fair to give such applicants a word of warning that the fees paid cannot be recovered after the case has been considered by the Examiner.

For these reasons it has been thought best to meet the inventor at the threshold of the Office and give him an opportunity to recover the moneys paid into the office, in the event of his failure to comply with the requirement.

Although misguided inventors may still persist in spending their money in attempts to furnish working models, there is much consolation to be found in a ruling which at least saves them the government fees on a hopeless application

Notes for Inventors

Tool for Attaching Wheel Tires A tool is shown in patent No 1,007,640 to James L Butler, Akron, Ohio, assignor to the American Tire & Rubber Co of Akron, for attaching a tire casing to a rim over compressible cores such as are now used in some tires The tool has a chain passed around the tire and rim and connected with a main lever so that the operation of the main lever may compress the casing and core, and the main lever is provided with a jaw to press the hooked edge of the casing into engagement with the rim flange and also means to guide it into such engagement

A Self-returning Exercising Dummy.—In patent No 1,007,028 to Wm P Armstrong, Washington, D C, assignor to The Strong Arm Mfg Co, is shown a dummy figure in the form of a man mounted so it can be rocked on a weighted base which has a rolling surface the bottom of which is flat so that the figure when knocked one way or the other will persistently tend to maintain or regain a fixed position A weight is connected by a suitable guided cord with the head of the dummy, thus aiding in the readjustment of the figure to its normal upright position

For Teaching Aviators.—Patent No 1,007,467 to Wm F Mangels of New York city is for an apparatus for teaching aviation and for testing aeroplanes and includes a car on a track and means for running the car at approximately the same speed as the aeroplane On the car is a frame and in the frame is suspended a power driven aeroplane and its operator, so the aeroplane can to a limited degree move laterally and lengthwise in the frame as well as up and down so the operator can drive the aeroplane at any speed and steer it in any direction, the car and its frame preventing dangerous accidents

Drying Wood by Electricity—Alfred Upton Alcock of Perth, Western Australia, in a patent No 1,007,513 provides an electric apparatus for drying timber, which includes liquid electrodes adapted to engage the ends of the piece of timber to be dried, a source of electricity and conducting wires which lead from said source and have their free ends immersed in the liquid electrodes to form a circuit

A Novel Toy—Many of us can recall trotting, when small, on the foot of some older member of the family who crossing his knee would seat us on his foot and bounce us up and down A toy (patent No 1,008,547 granted to Claudius B Johnson of Fulton, Mo) simulates this action by means of two figures, one representing an elderly person sitting with crossed leg and the figure of a boy on the raised foot, the leg being pivoted and a counterbalancing weight being within the body of the larger figure, so that the figure of the boy can be trotted up and down for a considerable period

Demand Abroad for Smoke Consumers.—U S Consul Carl Bailey Hurst, Lyon, France, writes that owing to an increase in the smoke nuisance a municipal order has been issued at Lyon calling attention of manufacturers and others to an ordinance of a few years ago with relation to thick black smoke The consul adds "There seems to be an opportunity of introducing up this vicinity smoke-consuming systems or devices Any printed matter advertising such will be displayed in this consulate, and brought to the attention of those most likely to be interested"

RECENTLY PATENTED INVENTIONS.

These columns are open to all patentees. The notices are inserted by special arrangement with the inventors Terms on application to the Advertising Department of the SCIENTIFIC AMERICAN

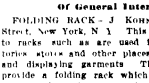
Electrical Devices.

WAVE DETECTOR—T H LYON, The Progess, 32 Morris Road, Southampton, England This invention relates more particularly to wave detectors of the kind known as rectifiers and which employ crystalline or crystalloid substances to be energised by electric oscillations and which may be employed in connection with wave meters as well as in the commercial and experimental sending of messages in wireless telephony and telegraphy.

Of General Interest.

FOLDING RACK—J KOHN, 117 W 10th Street, New York, N Y This invention refers to racks such as are used in garment factories stores and other places for supporting and displaying garments The object is to provide a folding rack which can be readily extended for safely supporting and displaying garments or other articles, or which can be folded when not in use to take up very little space

PROCESS OF REMOVING INK FROM PAPER—JOHN E RONSER, care of Morning News, Abilene, Texas This invention is illustrated in the accompanying engraving which is a diagrammatical view showing the apparatus that may be used in connection with



APPARATUS FOR REMOVING INK FROM PAPER.

the process The process removes printers' ink and analines from news, rag linen and bond papers, and pulps thereof The aim is to provide a process which will effectively remove the inks from papers so that the latter may be used again in the manufacture of other papers A further object is to provide a process which is comparatively simple and of great economy

LOCK BLOCK FOR PAPER ROLLS—J L OAR, 400 Victoria Avenue, Lynchburg Va In this case the invention is an improvement in plugs or brushes for use in paper rolls, being in the nature of a lock block which when inserted in the end of the paper roll will be locked therein from accidental displacement and will remain in position until the roll of paper has been used up

FRUIT PICKER'S LADDER—T O HERCHISSON, Waiterville, Ore The design is to furnish a ladder adapted for use in picking fruit and for use by painters and builders in any building operations and the invention provides a ladder including a movable platform easily adjustable to various heights for the purpose of picking fruit, erecting cornices, weatherboarding and painting houses, sand ing, sign writing and other work requiring the workmen to be elevated above the ground

COMBINATION COAT, HAT, PACKAGE, AND SATCHEL CABINET—W H JAY, Arcade Hotel, Le Roau, S D The aim in this improvement is to provide a cabinet having a locker and also having a satchel fastener arranged at the outside of the locker, and in which access to the locker, removal of the garment from the support, and the detachment of the fastener are controlled by a single lock on the door of the cabinet

COMBINED DRYING AND CONVEYING SYSTEM—A GRADY, 2703 South Seventh Street, St Louis, Mo This invention relates to a system for utilizing waste heat from a battery of boilers or the like in drying any material such as salt, saw-dust, or the like while conveying it from one point to another The system is readily accessible for the purpose of cleaning and manipulation

PACKAGE—W L BARTHERTON, care of W A Clark, Titanite Explosive Co, Corry, Pa This invention has in view a tubular container which is water proof and which can be inexpensively produced, the tube being constructed of paper or strawboard, or equivalent material, and given a coating of paraffin containing other ingredients of a water-proofing character

Heating and Lighting.

ACETYLENE GAS LIGHTER—H VAN HORNENBURG, Lake Placid Club Lake Placid, N Y The invention comprehends an electrically-operated gas lighter having two movable contact arms and mechanism connected with said arms for actuating the same, the parts being so arranged that the contact arms are brought into engagement with each other, a current is completed through them, and the arms are next separated in or near the path of the flame and are finally brought back to their respective normal positions, the arms thus making an idle contact, but without closing the electric circuit.

Machines and Mechanical Devices.

SAFETY DEVICE FOR ELEVATORS.—S. F. GLIMM, 3808 Avenue F, Brooklyn, New York, N. Y. This device is for use on passenger and other elevators. The invention refers more particularly to a device comprising in combination a lock for preventing the movement of the elevator car, means whereby the operator of the elevator can control the lock, and means controlled by the elevator door or other closure for controlling the first-mentioned means

REVERSING MECHANISM FOR POWER DRIVEN MACHINES.—C FREDERICKSON, Rice Lake, Wis. Among the principal objects which the present invention has in view are: the provision of a simple, efficient and durable means for varying the speed in transmission from a driving to a driven shaft; and to provide a mechanism of the character set forth, simple and effective in operation. The mechanism may be used in conjunction with any suitable machine

MOLD FORMING MACHINE.—C E SIMPSON, 640 Gallis Street, Portsmouth, Ohio. This continuously automatic acting machine employs an endless chain of carriers provided with pattern plates adapted to receive and deliver molding frames for the formation of drag and cope molds, it has a series of successively connecting pattern plates and an intermittent feed mechanism arranged to advance each of the plates to and from stations where the facing sand and ramming sand are delivered to the mold and to a station where the sands are rammed

FEED TABLE FOR TENTERING MACHINE.—B GARDNER, East Greenwich, R I The principal purpose of which the present invention has in view is to provide tension devices for feeding the cloth to the reciprocating bed of a tentering machine, and a take-up mechanism for lifting the slack of the cloth due to the return of the bed of the tentering machine constructed as mentioned

MECHANICAL EYES.—P C JACQUEROD, West New York, N J In the present patent the invention has reference to mechanical eyes for dolls, lay figures, or other use The object of the improvement is the provision of a practicable construction whereby the eyes may be capable both of the ordinary opening and closing movement, and of moving laterally.

Prime Movers and Their Accessories.

IGNITER FOR INTERNAL COMBUSTION ENGINES.—C MESSERSCHMID, 696 Bergen Street, Brooklyn New York, N Y This invention is an igniter or spark plug for gas and other internal combustion engines which is designed to operate on high and low tension circuits It is provided with a pair of jump spark electrodes and a pair of make-and-break spark electrodes operable exchangably, according to conditions The last named are preferably operated by an electromagnet incorporated with the plug structure The electrode carries the high tension electrode which extends therethrough and terminates in proximity to a fixed spark point to the inner end of the plug

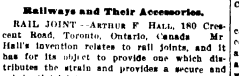
BILGE PUMP.—G E BADGER, Mayger, Ore In this case the aim is to provide a rotary pump for handling which is driven by a friction wheel which may be thrown into and out of engagement with the flywheel of the engine by a system of levers and connecting rods which are operated by a treadle

ROTARY MOTOR.—J MACKEY, Steamboat Springs, Colo In the motor forming the subject of the patent obtained by this inventor there is a rotor having peripheral blades and mounted on a hollow shaft having a slide valve, controlling openings in the hollow shaft and in the hub of the rotor An auxiliary casing is mounted on the shaft at one side of the rotor through which the motive fluid passes to the exhaust

SPARK PLUG.—W S WITTER, Toledo, Iowa, In this invention the improved plug consists of a case cylindrical in form and provided with means for engaging an engine cylinder and having a plunger acted upon by the compression and moved in one direction thereby, and in the opposite direction by a solenoid coil of which the plunger forms the case.

Railways and Their Accessories.

RAIL JOINT—ARTHUR F HALL, 180 Crescent Road, Toronto, Ontario, Canada Mr Hall's invention relates to rail joints, and it has for its object to provide one which distributes the strain and provides a secure and substantial joint, presenting a smooth and continuous surface to the wheels. Another object is to provide a rail joint which will protect the ends of the rails The accompanying illustration presents a side elevation of the invention The neighboring ends of two rails are indicated by the dotted lines midway the saddle members used with the joint and shown in position. The saddle in connection with the heads of the rail presents a smooth and continuous surface to the wheels, and the wheels pass over the saddle the strain the pieces is distributed through the length the saddle, thus greatly reducing the possibility of fracture of the parts.



RAIL JOINT.

GRAIN CAR DOOR.—J. C. DOBIE, Onawa, Iowa, and J. L. ROBB, Anistead, N. Mex., assignors of E. M. Hoover, 808 N. Adams Street, Carroll, Iowa. Among the various provisions of the invention are: To provide in a car a door which preserve the thickness of the wall of the car when the door is open; to provide a door and frame to prevent warping or disarrangement of the door to permit leakage to pass the same; to provide a holding frame for a door to maintain the latter in locked position; to provide a plate-metal sill to support the door and form a guiding track therefor; to provide a door to prevent obstructive lodgment of articles behind the door when the same is closed; and to provide a chute in said door for the handling of grain or flowing freight.

RAILWAY RAIL AND TIE FASTENER.—J. S. SHORT, 1015 E 11th Street, Chattanooga, Tenn. This invention is especially adapted for use with reinforced concrete ties The object is to provide a device which will easily and securely hold the rail in position on the tie. Another object is to provide a means which is cheaply produced and which will consist of few parts, thereby lessening the cost of such devices in railroad constructions.

SPIKE HOLDER—J M POWELL, Los Gatos, Cal The object here is to provide a holder, having parts thereon for engagement with a tie plate on rail chair and another portion for engagement with the web of the rail, the holder when in normal position being in contact with the head of a spike, whereby the spike is held against loosening and the danger of spreading rails is obviated.

RAILROAD TIE—J F O'NEILL, 159 East Front Street, Trenton, N J An object of the inventor is to provide a tie, preferably made of concrete, which tie is composed of a series of parts flexibly fastened together, two of said parts carrying the pair of rails, and so disposed that these parts will give slightly as the wheels of the train pass over the rails.

Pertaining to Recreation.

SWING—G. D. TUCKER, Meridian, Miss. The oscilating motion of this swing traverses the support for the swing over the ground An object of this invention is to provide a support rotatably supported on suitable rollers, with means for driving one or more of said rollers by the swinging motion of the swing, so that the device as a whole will move over the ground, and if desired about a common pivotal point Another object is to provide means so that the swing may be moved while the device as a whole remains stationary on the ground

Pertaining to Vehicles.

COMBINED SECTIONAL TIRE AND WHEEL RIM.—FRANK M. HURST, 222 McDougal Street, Brooklyn, New York, N Y Some advantages over other tires, in this invention, are 1 In case of puncture it is not necessary to stop and repair, as puncture of one ball will not injure any other part of tire and one can continue to one's destination or can repair at once in a short time 2. A tire blow-out while going at high speed has caused the loss of many lives and the wrecking of machines This will not be the case if one of these balls blows out, as the rest of the tire will not collapse 3 Requires no pumping up 4 There is no necessity of having tire chain to prevent slipping 5 Skidding has been brought to a minimum. 6. Any injured part



COMBINED SECTIONAL TIRE AND WHEEL RIM.

can be replaced without tools 7. The small cost of a section of this tire in comparison to a new one of any kind. 8 If the saving of a life is the only thing to be considered, it would alone be worth many times the cost of any other tire Life is worth the price of a sectional safety tire No one knows when one will be running at high speed and a tire "blow-out" which will wreck the machine and perhaps cost owner and friends their lives or broken limbs 9. The inventor will sell one-half interest in this patent to further its progress and will take out patents in four European countries. A side view of a wheel with sections of the tire in position is shown herewith.

NOTE.—Copies of any of these patents will be furnished by the SCIENTIFIC AMERICAN for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

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PROPOSALS.

PROPOSALS FOR BRICK DORMITORY, CENTRAL STEAM HEATING AND ELECTRIC PLANT. Department of the Interior, Office of Indian Affairs, Washington, D. C., November 15, 1911. Sealed proposals, plainly marked on the outside of the sealed envelope: "Proposals for Brick Dormitory, Central Steam Heating and Power Plant, for the Rapid City Indian School, South Dakota," and addressed to the Commissioner of Indian Affairs, Washington, D. C. will be received at the Indian Office until 1 o'clock, p. m., December 26, 1911, for furnishing materials and labor for the erection of a brick dormitory, central steam heating and power plant, at the Rapid City Indian school, South Dakota, in strict accordance with the plans, specifications and instructions to bidders, which may be examined at this Office, the offices of the Superintendent of Construction, Denver, Colorado, the American Contractor, Chicago, Ill., Scientific American, New York City, the Improvement Bulletin, Minneapolis, Minn., the Journal, Rapid City, South Dakota, the Bee, Omaha, Neb., the United States Indian Warehouses at Chicago, Ill., St. Louis, Mo., and Omaha, Neb., the Baltimore and Ohio Railroad Depot at St. Paul, Minn., and at the school. For further information apply to the superintendent of the Rapid City Indian School, Rapid City, South Dakota. C. F. Hauke, Acting Commissioner.

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(12576) L. W. asks: Will you please give me a clear definition of "power factor" and "KVA," expressions used in electrotechnics, and illustrate same by example? A. "The 'power factor' of an alternating current circuit, or apparatus, is the ratio of the electric power in watts to the apparent power in volt-amperes." This is the definition as given in the Standardization Rules of the American Institute of Electrical Engineers. It is official. The true power of an alternating current divided by the apparent power, which is the volt-amperes entering the apparatus, gives the power factor. The volt-amperes apparently entering the apparatus multiplied by the power factor give the true power of the apparatus. The apparent power is the KVA, the kilo volt-amperes. You will find this fully explained in Sloane's "Handy Book," which we can furnish you for $3.50.

(12577) W. D. C. asks: Why does the honeysuckle vine grow to the left just contrary to the growth of all other trailing vegetation? All vines seek the sun or grow to the right, except the honeysuckle. Why is this? A. Many plants twine in the spiral or a right handed screw, or "against the sun," or "from left to right." The common garden bean and the wisteria have this habit. Other plants like the hop and honeysuckle twine in the opposite direction, presenting a spiral of a left handed screw. A most interesting account of these phenomena will be found in Darwin's "Movements and Habits of Climbing Plants."

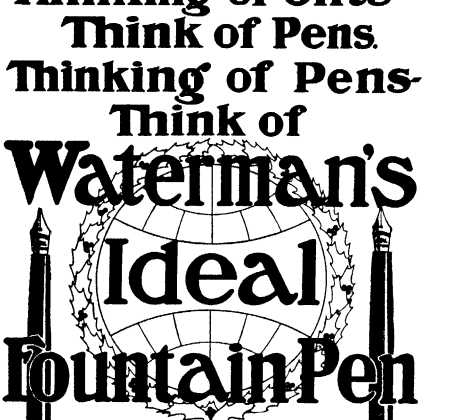
(12578) F. L. Y. asks: How high does a person have to go before the earth becomes invisible to the sight? Any object is just visible which *like* one minute of arc. The earth will subtend an angle of one minute at a distance of a little more than 27,000,000 miles, and hence would be visible as a point at that distance, but would not show any disk.

(12579) D. E. says: I notice in a recent number of your paper an item in which you say that some process of restoring the appearance of a felt hat, that had become some what rusty, would fill a long "felt" want. I have solved this problem by wiping my hat with the same cloth I polish my shoes with. The blacking I use does not "crack" when applied to the hat and an occasional application keeps it looking nice.

(12580) R. F. McK. says: Please give me a solution of the following. If a tube 3 feet high and 6 inches in diameter is filled with water, and has a piston fitting the tube 1 inch in diameter, will the force required to push the plunger up in the tube 1 inch equal the force required to lift a column of water 1 inch in diameter and 3 feet high to the height of 1 inch? A. The pressure of water in the tube is equal in all direction at any given point. At the moment your plunger starts to rise, it is resisted by a head of 3 feet of water, that is, by the weight of a column of water 3 feet high and the area of the plunger. But as the plunger rises, the height of the column decreases. If you had a tube around the plunger, raising the plunger 1 inch would raise the entire body of the water in the tube 1 inch, and the plunger would operate under a constant pressure equal to 3 feet head of water, but in the illustration you give the rise of the plunger of 1 inch will cause a very much smaller rise of the surface of the water, so that when the plunger has completed its lift of 1 inch it will have little more than 35 inches of head of water above it, and the average pressure will therefore be about 35¼ inches of water. Obviously, if your plunger traveled the whole 3 feet and came to the surface of the water at the completion of the 3 foot travel, there would be no pressure against the plunger due to water head, since the plunger would emerge from the surface of the water. Similarly, the pressure on the plunger decreases with every inch of its travel upward.

(12581) J. C. J. asks: If a substance could be found which is heavier than water and *less compressible*, would it sink in any depth of water? A. If a substance could be found which is slightly heavier but less compressible than water, it might sink in water till it had reached the place where it was of the same density as the water at that place and there remain. The water at the bottom of the ocean *is* about 1/20 denser than at the surface; hence this supposed material could not be as much as 1/30 heavier than water at the surface of the ocean. No such material is known to exist.

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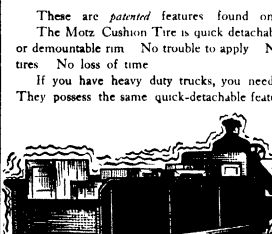
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The American Merchant Marine

To the Editor of SCIENTIFIC AMERICAN:

A correspondent in a recent issue of the SCIENTIFIC AMERICAN set forth the difference in the cost of operation of steamers operated under the United States navigation laws and those which operate under the navigation laws of foreign countries. The higher wages and feeding stipulations are given as the reason that the cost under our laws would amount to something like $6,000 on the average sized tramp plying in foreign trade against the American owner, even though the laws allowed him the privilege of buying foreign tonnage and securing American registration. This is true. But why should our navigation laws compel an American citizen to employ American crews in foreign trade? Even under the present subsidy laws under which a few American lines operate, the number of Americans employed is limited. Why should not an American shipowner have the same right to employ whom he pleases as has an American railroad builder or any other employer of labor?

This year we have the greatest movement in export cotton that the United States has ever seen. All moving in foreign tonnage. Our Gulf and West Indian trade is constantly increasing and it is practically carried on with foreign built and owned tonnage. The earnings of foreign tonnage this year due to the immense export movement from the United States as well as from goods imported will be tremendous and the various owners and investors abroad will receive heavy dividends. As the United States are not investors in foreign shipping, nothing will come to this country for distribution in the way of dividends. In this great fleet that operates under the flags of foreign nations, is no American sailor. Under present conditions we pay the freight, but we distribute nothing in the way of dividends to Americans.

Our navigation laws say that we must employ so many sailors on American ships—so many according to tonnage of the ship. Yet the navigation laws have killed American shipping in foreign trade. Hence there are no American sailors in foreign trade. Of what benefit are the navigation laws?

There is another statement that your correspondent made, and like many similar statements of a erroneous nature, retards the solution of the restroation of the American flag to the deep sea trade. The particular statement that I now refer to is that the "German government guarantees a dividend to the North German Lloyd of 7 per cent on its stock." Of course this is taken as subsidy payment and if it were true it would be a subsidy, but it is not, but it is astonishing that such statements continue to be made when the truth can readily be ascertained. Now the facts are that the North German Lloyd paid 3 per cent dividend last year and 1½ per cent the year before and before that nothing. The North German Lloyd is pre-eminently a passenger line and in the panic of 1907 cut into its earnings heavily. Fast passenger steamers have their advantages for the United States trade as well as they have for foreign, and fast steamers under the American flag are desirable.

It might be well held, that for certain routes, under the American flag, mail subvention is necessary to enable the American line to establish itself. But this policy has been so far ineffective because of the extraordinarily higher cost of building in the States as compared with the cost of the foreign builders, and this condition will have to be adjusted ere the mail subvention act will have any beneficial influence on the shipping industry of the United States. The one thing that will stimulate American interest and investment in shipping is to give Americans the right to engage *tot* the world's commerce on the same terms that favor foreigners. Give the right to an American to buy a foreign steamer and grant it American registration. Give him the freedom as to crews that foreign steamship owners enjoy. Compel him to have American officers. Steamers so registered to engage in foreign trade only.

To-day we have practically no American steamers engaged in foreign trade and no American sailors, so the continued opposition to a free ship policy is difficult to understand. We can hurt no American interest in foreign shipping as there is no American interest to be hurt. If it hurts any interest it will be that of foreign steamship interests.

Why is the present policy continued? Possibly in the hope that the Americans will be willing to allow a wide-open subsidy bill to finally become a law, and possibly to the fact that shipping generally is but little understood by the American people. But the interest is growing and growing rapidly and the interest taken in the Panama canal is stimulating investigation. Ere the Panama canal is opened it will be recognized that the restoration of an American merchant fleet to the deep sea foreign trade is but second in importance to the tariff as an issue in which the country is vitally concerned.

Some time ago President Bowles of the Fore River Shipbuilding Company stated that it would take ten years to build a fleet that would carry the sea commerce of the year 1910. Yet all the time our over-sea commerce is increasing yearly. It has recently been given out, that our domestic shipyards with government work and the orders for steamers to be ready for operation on the opening of the Panama canal, have all the work they can handle. What then shall the American people do? Rest quiet and allow foreign shipping nations to reap the benefit of our investment of $400,000,000 in the Panama canal? Is that what the United States built the canal for?

Let the American people answer.

Chicago, Ill. CHARLES DEPREZEE.

The Technique of Clam Digging

To the Editor of SCIENTIFIC AMERICAN:

"It pays to advertise" is something we often hear, and it certainly does, but the statement you made in a recent ad. in the *Literary Digest* regarding the technique of clam digging does not add any luster to an advertisement, as it is so very evident that the party who wrote the ad was a long way off from his subject.

Now, this is not in the sense of a knock, for only people who live along the coast are supposed to know anything about digging clams in the commonly expressed sense of the words. Everybody who lives in the Puget Sound region has an opportunity to know that you do not dig clams out of a boat with a rake, and I presume that our eastern clams have the same habit of keeping far below the rake's reach.

I like the SCIENTIFIC AMERICAN so well that I dislike to see any misstatement of this sort, therefore I am telling you that the way we dig clams in this country is to take a good stout spade or fork, and go down to the beach when the tide is out, and get busy just the same as you would to dig potatoes. Still, perhaps I should explain to the man who wrote the ad that you do not dig potatoes with a hayrake. In any event, I hope the information will be of some use, as it is given in all good friendship.

Seattle, Wash. HUGH N. JOHNSON.

The Current Supplement

IN the present issue of our SUPPLEMENT, No. 1876, Prof. Woodworth discusses the Psychology of Light or, in other words, the subjective aspect of the science of optics. Mr. Coleman contributes an article on modern methods of bunkering steamers. A very interesting topic treated in this number is that of fireless locomotives. Malaria is one of the most widespread diseases, and its study has of late been receiving a great deal of attention, with results which are most gratifying. Some facts about malaria, derived from Dr. Howard's govern-

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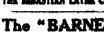
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ment publication, and a summary prepared by Sir Roland Ross, are presented in this issue. Many have marveled at the extraordinary power which carrier pigeons possess of finding their way back to their home. A scientific discussion of the *modus operandi* of this remarkable performance is discussed in an article by M. Tovia.—Insect aviation presents certain features which are not as yet incorporated in artificial aviation as practiced by man. The subject is lucidly expounded in an illustrated article derived from *La Nature*.—The Sixty-Inch Reflector of the Mt. Wilson Observatory is briefly described.—An article reproduced from *Engineering* tells how the government aids the man out-of-work in France.—A. P. Thurston discusses from a scientific standpoint the stability of aeroplanes.—We have become accustomed to the term "plant psychology." The senses of plants forms the subject of a brief article derived from *La Revue*.—Major Squier, the originator of the system, describes the use of wire directed electric waves in multiplex telephony and telegraphy.

The Strength of an Aeroplane

(*Concluded from page 558*)

other is to allow streams of smoke to flow past the model. Both methods show the direction of flow at all parts of the current except where the eddies are so violent as to make the thread flutter and the smoke streams break and lose their identity. The thread is more convenient to use than the smoke, but if too long will not accurately coincide with the stream-line, owing to the effect of tension. The smoke coincides with the direction of flow at all points, and, as Prof Marey has shown, may even indicate the velocity at all parts of the current, if the smoke-streams be emitted from nozzles vibrating at a known rate transversely to the current. In this case the smoke streams are wavy, and show by the number of waves per inch what is the speed of the current at the place of observation. The number of waves per inch can easily be counted on a photograph of the model and of the smoke-streams surrounding it. Indeed, the velocity and direction of flow for an entire longitudinal section of the current about the model may be realized by a glance at the photograph if the smoke streams surrounding it. Indeed, the comb placed transversely to the current and vibrated lengthwise, say ten times per second, as done by Marey.

Mr. Curtiss is at present trying different methods of producing distinct and clearly visible lines of smoke. At first air was sucked over the surface of ammonia in a bottle, thence over hydrochloric acid in a second bottle, thence through holes in a tube placed across the wind current. But the smoke so produced is pale and requires good lighting in a dark wind-tube to render it distinct enough for easy observation and photography. It is hoped that a simple method may be found whereby dense black smoke streams may easily be produced and led into the current.

The absolute velocity of the air in the Curtiss wind-tube was found by a screw anemometer to be about 25 miles per hour at the middle of the current. The relative velocity at different parts of a section of the current was found by observing the deflection produced on a straight exploring wire, like a knitting needle, ten inches long, suspended from a horizontal wire fixed transversely to the stream. When the point of suspension of the exploring wire was moved across the tube, the suspended wire was deflected from the vertical less and less as it advanced from the mid section toward the lateral wall. The impact pressure of the air against the wire is proportional to its displacement along any longitudinal line of the current. Hence, of course, the velocity is as the square root of such displacement. In this manner the speed of the current was observed to decline about two per cent from midstream to within two inches of the lateral wall, as previously stated.

The wind-tube and tension tongs described in this article were designed by Mr. Curtiss and Dr. Eahm, who were experimenting together. Two other contrivances were devised for finding the tension in aeroplane wires; one being an instrument for giving the pitch of the wire in vibration, the other being an in-

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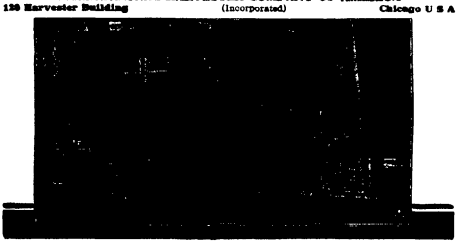
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strument for showing the lateral displacement of the wire by a given force, from which the tension could be read in a reference table or along a specially designed index scale.

Some Locomotive Curiosities

(Concluded from page 555.)

were connected by crossed rods as will be understood by examining the illustration. This engine never did practical work. It was jacked up clear of the ground and tried under steam in January, 1856, at Kew, near London, where it was sharply criticized by some engineers. The writer saw it in the early sixties when it was fast rusting away in the stable yard of an inn near Kew Bridge.

Double piston balanced locomotives were patented by Bodmer in 1834, and some engines were built for English railways in 1842. The rod of one piston worked within the hollow rod of the other and they were connected to oppositely disposed cranks, which were four in number. As the mechanism was internal and the appearance of the engines differed in no wise from the ordinary locomotives of the day, they are not illustrated here.

The next remarkable locomotive selected is illustrated in Fig. 6. This engine was a partial repetition of the "Hurricane" (Fig. 2) for the boiler and running gear were on separate frames. It was designed for the Philadelphia and Reading railroad by G. W. Nicholls and was put to work in 1847. This engine was appropriately named "Novelty." The cylinders were 18 inches in diameter by 20 inches stroke. Driving wheels 3 feet 10 inches in diameter. The weight of the engine proper was 21 tons, and the frame carried a cylindrical iron water tank which had the appearance of a boiler. This was used as a condenser and feed water heater, while the boiler was carried on a separate frame behind the engine. This, in turn was coupled to a tender which does not appear in the illustration. The boiler had return flues and burned anthracite coal. It had a total heating surface of 1,085 square feet. The fire was urged by a fan placed in the cab. The condenser tank was surmounted by a large smoke stack, but as nothing passed through the latter save the surplus exhaust steam from the condenser it was apparently placed there merely for appearance. Steam was carried from the boiler to the engine by a jointed pipe. This engine hauled coal trains of 750 tons at 10 miles an hour. This complicated piece of machinery only worked for a short time.

Complicated machinery is not, in itself, objectionable, and when complication enables a necessary function to be better performed it is allowable, but one can scarcely see how such a machine as is illustrated in Fig. 8 could have been seriously considered in the light of modern practice. Nevertheless, this engine was built in 1881, and ran on the Canada Southern Railway. It was designed by Eugene Fontaine. The cylinders were 16 inches diameter by 24 inches stroke. The engine weighed about 40 tons. The driving wheels were 6 feet in diameter, having frictional contact with wheels 4 feet 8 inches in diameter, which were integral with wheels 5 feet 10 inches in diameter running on the rails. In other words instead of propulsion by power applied directly to the rails as in the common locomotive, two extra wheels were interposed to effect the same result. The "Fontaine" was a fast engine, for it drew two coaches 111 miles in 98 minutes, but many ordinary locomotives traveled faster with heavier loads. Geared engines were tried as far back as 1838, but it was then found that a gain in speed meant a loss of power, and as locomotives are required to haul loads, those engines were short lived. The "Fontaine" engine was not original, as the same arrangement was patented in England by Johnson in 1848.

The foregoing notes will, perhaps, give a good illustration of the adage that "History shows us what to avoid."

Caryl Davis Haskins

CARYL DAVIS HASKINS one of the best known electrical men of this country, died Saturday morning, November 18th, in Salt Lake City. Mr. Haskins

The Technique of Clam Digging

It has a technique and it is not easily learned. There is a certain way of handling the boat, of pushing the rake with its absurdly long handle into the water, of scraping the clams into it, of raising the rake—why there is as much technique about it as there is in playing a piano. You may debate with a disputatious person if it is more useful.

Probably there isn't any book on the technique of clam digging and there isn't a periodical devoted to it exclusively.

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See Correspondence Column, Page 564.

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was stricken with pneumonia while on a business trip in the West and the end came very unexpected.

Mr. Haskins was born in Waltham, Mass., May 22nd, 1867, and was educated in England where he specialized in mathematics and physics and took a special course in surveying and fortification work. In 1888 he entered the employ of the S. Z. de Ferranti & Company as one of its junior assistant engineers, where he had charge of the manufacture of electrical meters and assisted Mr. de Ferranti on the drawings for the original Deptford electric light station

In the autumn of 1889 he was a designing draftsman in the Thomson Electrict Welding Company, Lynn, Mass Two or three months later he was employed by the Thomson-Houston Electric Company, Lynn, Mass., as an electrical engineer. In 1891 he was appointed manager of the Meter Department of this company and after its consolidation with the General Electric Company, Mr. Haskins retained this position, including general supervision of the engineering and the manufacture of instruments

At the beginning of the Spanish-American War Mr. Haskins proffered his services to the government and organized a corps of electrical engineers and men trained in electrical work, of which he was made commander In the laying of the submarine mine defenses of Boston Harbor, the erecting of search light and ranges finding stations and other similar work during the war, Mr. Haskins and his command gave valuable service He also gave invaluable aid in an advisory capacity in connection with other defense work on the north Atlantic coast Under his supervision the temporary generating stations at Fort Warren and Fort Nahant were erected as well as all the range finding and communicating stations on the New England coast The work in Boston Harbor involved the charging and laying of some 200 mines. At the conclusion of the war, Mr Haskins resumed his position with the General Electric Company He had made a special study of electricity as applied to offense and particularly defense in time of war and was considered an authority on this subject. After the close of the war he frequently acted in an advisory capacity to the government in matters of this nature

Mr Haskins was a member of the American Society of Mechanical Engineers, the American Institute of Electrical Engineers, of the National Electric Light Association, and associate member of the Military Service Institute and the U. S Naval Academy

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PHYSIKALISCHE ZEITSCHRIFT 12 Jahrgang 1911. Seite 540-546. Struktur und Optik grosser Kristalltropfen Von O Lehmann.

KONISCHE STRUKTURSTORUNGEN BEI FLUESSIGEN PSEUDOKRISTALLEN Von O Lehmann Sonderabdruck aus den Verhandlungen der Deutschen Physikalischen Gesellschaft. XIII. Jarhgang Nr 8 Braunschweig Druck von Friedr Vieweg & Sohn, 1911

UBER MOLEKULARSTRUKTUR UND OPTIK GROSSER FLUESSIGER KRISTALLE Von O Lehmann Separat-Abdruck aus den Annalen der Physik Vierte Folge Band 35 Leipzig Johann Ambrosius Barth, 1911

DIE UMWANDLUNG UNSERER NATURAUFFASSUNG INFOLGE DER ENTDECKUNG DES RELATIVITATSPRINZIPS Von Geh. Hofrat Prof Dr O Lehmann, Karlsruhe Vortrag gehalten im Karlsruher Naturwissenschaftl Verein am 2 December 1910

DAS RELATIVITATSPRINZIP DER NEUE FUNDAMENTALSATZ DER PHYSIK. Von O Lehmann Sonderabdruck aus dem 23 Band der Verhandlungen des Naturwissenschaftlichen Vereins Karlsruhe Druck der G. Braunschen Hofbuchdruckerei, 1910.

These publications contain careful studies of Prof Lehmann's investigation of liquid crystals. If there can be any doubt that our definition of the word "crystal" must be revised, surely Lehmann's work must dispel it

DER MENSCH DER VORZEIT. Von Wilhelm Bolsche. Stuttgart: Kosmos, Gesellschaft der Naturfreunde, 1911.

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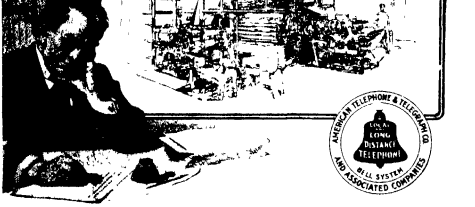
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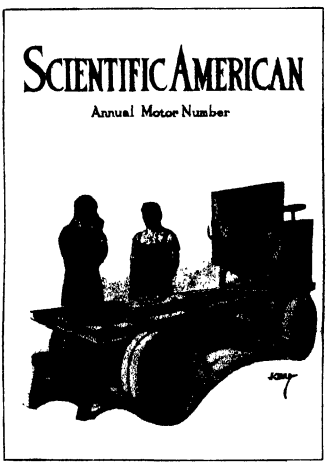
ANNUAL MOTOR NUMBER

MOTOR CARS MOTOR TRUCKS MOTOR BOATS MOTOR CYCLES

JANUARY MAGAZINE NUMBER OF THE SCIENTIFIC AMERICAN

ISSUE OF JANUARY 6, 1912

Although we are well past the dawn of the "hydrocarbon age," we have not yet reached the meridian period. Each year there are new developments making for the betterment of motor-driven land and water vehicles. The improvements that are to be brought out in 1912 are exceptionally interesting and will be outlined in detail in this number. The following articles will appear:



Selection of a Motor Truck

In what respect do leading types of motor trucks for 1912 differ mechanically? How can the owner best protect his investment? What are the costs of upkeep and operation as compared with those of horse-drawn trucks? Can truck chauffeurs be made of ordinary teamsters? These are vital questions to the intending purchaser of motor trucks, which will be ably discussed.

Will Rubber Tires be Supplanted?

While tire manufacturers are doing everything that is humanly possible with rubber and fabric, yet, undoubtedly, there is no feature of a motor car that gives the owner more concern than the tires. The ability of rubber to stand up under the terrific shocks and wearing grind of service is a marvel. Hundreds of inventors have been busy at the task for years, no substitute for the rubber tire has yet been developed to such a degree as to supplant the standard pneumatic tire. Just what has been done in the past, and what promises are held for the future, will be brought out in this article.

The New God of War—Gasoline

In this article the prominent place occupied by the automobile in European military maneuvers is described. In the United States the armored automobile has been entirely neglected. In Germany in time of war every car in the country, private as well as public, is placed at the beck and call of the Government.

Auxiliary Uses for Motor Vehicle Engines

Herein are described a number of novel uses for the engine of a motor truck or an automobile.

The Comparative Cost of Light and Heavy Cars

This question is debated by a man who has made painstaking and impartial comparison of every detail of his personal expenses in connection with two cars, one a typical light car, and the other a standard heavy car.

Making the Starting Crank Obsolete

One of the most noticeable features of the 1912 car will be the absence of a starting crank in front of the radiator. The desirability of providing a means for starting the car from the driver's seat was expressed years ago, and its necessity has been urged more clamorously each year. Now, suddenly, a score of different self-starters have been developed, and the majority of manufacturers are going to bring out their 1912 cars with some sort of a self-starting mechanism. The leading types of self-starters will be explained so that any automobile owner can understand them.

Driving the Car at Night

To obtain the full value of a motor car, it must be available for service at night as well as during the day time. There is much more to safe night-riding than a pair of powerful headlights. There are new developments which every automobilist should know.

The Easy Riding Car

The pleasure vehicle has now become so standardized that the riding qualities of an automobile receive much more attention than heretofore. As a consequence, designers have been devoting much thought to the springs, shock absorbers, upholstering, the balance and hang of the body, and all the features that enter into the making of a comfortable car. The prospective purchaser should know that the distribution of weight on a car is an important factor in making it "stick to the road." A badly-balanced car will possess poor traction qualities owing to the tendency of the rear wheels to bounce off the road's surface.

A Fertile Field for Inventors

Under this subject are detailed many ingenious devices that inventors have developed of late for use on automobiles.

Lessons in Everyday Motor Boat Designs

The racing motor boat is very properly considered a useless craft for pleasure purposes. In the present article, however, it is clearly brought out that the design of the pleasure boat has been materially improved by the development of the racer.

Motor-Cycle Developments

What is being done to improve that noisy, sputtering, two-wheeled vehicle? Among the prominent features for 1912 are footstarters, multiple jet carbureters for slower running in cities, improved mufflers, and floating seats to make riding more comfortable.

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Extracting a steel splinter from the eye of a workman.

POWERFUL ELECTROMAGNET FOR THE USE OF OCULISTS.—[See page 573.]

SCIENTIFIC AMERICAN

Founded 1845

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The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *strictly* like articles *worth* and the facts *authentic* the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

The purpose of this journal is to record accurately, simply, and interestingly, the world's progress in scientific knowledge and industrial achievement

Navy Yard Politics

TIME was when the navy yards of this country were dominated by the politician. During the last two decades they have gradually been emancipated from political interference, and, but for recently-enacted legislation, it would have been possible to say that the work of upbuilding of our navy, both at the yards and by private contract, was proceeding without let or hindrance. But, unfortunately, certain hasty and ill-considered legislation by Congress in 1910 and 1911, passed in the interests of navy yard labor, has so seriously handicapped the private shipbuilders, by whom, of necessity the larger part of our new ships must be constructed, as to discourage them from bidding upon government contracts, thus most seriously threatening the future development of that arm of the service upon which the United States must depend for its future security and permanence.

We refer to the eight-hour law, which renders it obligatory upon contractors for new ships to limit the hours of labor upon ships built for the government to eight hours a day.

The law of 1910 was extremely vicious and objectionable in its effect, and the 1911 law goes far beyond it, in that it is so indefinite in its terms that it is impossible to tell how it would be interpreted by the courts. Furthermore, failure to comply with it automatically stops all payments for the work in progress, leaving the contractor to face the probability of long and expensive litigation, with uncertainty as to the outcome, before he may or may not receive the contract price of the vessel. The present law, as it is written, is vicious as to form and indefinite as to terms.

In regarding the law in its broad economic aspects, there are many sides of the subject that should be considered. In the first place, the government is not merely making a general law applicable to all of the material that it purchases, in fact, in the manufacture of these same ships that are to be built by eight hour labor, all of the armor and a large part of the guns, the ammunition and the outfit, all of the electrical auxiliaries, the steel plates and shapes, and other parts entering into the vessel that are not built by the shipbuilders, will all be constructed without restriction as to hours of labor.

Nor is any attempt made to limit the hours of labor of the manufacturer of the shoes and other clothing for the army and the navy, the manufacturer of the paper and other supplies used in all of the departments of the government, or any one of the other general supplies, but shipbuilding is singled out as the one industry that shall be assaulted by the powers in Congress.

Every one of the large shipyards in this country is engaged both in merchant and naval work, and, most of them, in other lines of manufacture. It is everywhere recognized as a practical impossibility to run different hours on different jobs in the same plant. It is not possible to build a merchant ship on one slip, where all laboring men and mechanics are employed from seven to six with an hour at noon; while on the slip next to it there is building a government ship, upon which the men work from eight to five, with an hour at noon; nor, in a machine shop, can one-half of the tools be started at seven, to work until six on merchant work, while the other half are started at eight to work until five on government work.

While it may be possible, by various subterfuges, to avoid the present wording of the law, this would merely mean a change, when the next naval appropriation act is written, to more closely tie the hands of the contractor; with the ultimate result of either forcing him to entirely abandon government work, or to place all of the work in his yard on an eight-hour basis. Let us observe the results of these two contingencies.

If government work is abandoned, he is then no longer restricted by the requirements of any law that may be passed, but he has given up what is to every large shipbuilder in this country so important a percentage of his business as to render his very existence uncertain, and the effect might be to oblige many of the shipyards to close their gates. This would mean that all naval work must be done at navy yards, a consummation most thoroughly in accord with the desire of the large group of navy-yard-labor politicians. This, however, would result in an increased cost of the ships of our navy of not less than forty per cent, as is clearly shown in the case of the "Florida," which has cost for direct labor and material nearly $6,400,000, as against the purchase price of the sister vessel, the "Utah," built by private contract, of about $4,000,000.

If, on the other hand, the shipyards accept the second contingency and proceed on a strictly eight-hour basis, they are then at a great disadvantage in their competition for other than government work. In all of the shops where tools are worked, the decrease in production due to the shorter hours will be directly in the proportion to the time, or a decrease of twenty-five per cent while the wages of the men will unquestionably (as every manufacturer of experience knows) be increased, so that their yearly income will be unchanged—a further burden on the cost of production of twenty-five per cent. In other parts of the works, where labor is of a different character, by working piece-work prices, it is probable that the production in eight hours can be brought up nearly to the standard of ten hours; but the ultimate result will be an increase in the cost of the labor entering into the production of by twenty-five to ten per cent, according to the character of the work. How much this means in merchant work or repairs, or in the miscellaneous work done by practically all of the shipbuilders in competition with other manufacturers, needs no careful argument to explain.

Where the government is concerned, it will mean, as it already has in the case of the "Texas," a very considerable increase in the contract price, and this, in effect will amount to a direct *subsidy* to labor by a government that has repeatedly rejected the subsidy idea when applied to helping the shipbuilding and shipowning industries of the country.

While many other arguments may be urged, we believe that the above outlines the principal ones that should be kept clearly in view in the consideration of the present anomalous condition, in which Congress singles out one particular industry, struggling with unremunerative conditions, and harasses and burdens it with the effects of an indefinite and ill-designed law, applicable only to work done for the government, while at the same time it passes by the greater and stronger industries of the country, which supply yearly to the government, directly or indirectly, many times more in value than do the shipbuilders. As matters now stand, both parties in Congress willingly subsidize labor on shore to the amount of $8,000,000 annually, but steadily refuse to subsidize labor working on the high seas a single penny.

A Ray of Light in the Darkest Province of Chemistry

WE have in our day a vast army of trained scientific workers, and methods of research have been so far standardized that practically any man of sound intellect and reasonable dexterity can turn out original work, provided he receives the right training and possesses the requisite determination and perseverance. But while there is thus going on a general filling out of the gaps in the existing network of our knowledge, it is given to comparatively few to do something far more than this, to open up an entire new field along an untrodden path, by methods specially devised for the purpose. It is such achievements as this which distinguish the great dominant spirits of science, the Newtons, the Maxwells, and Pasteurs. The works of such men, as we look into the past, stand out like milestones along the avenue of the progress of science through the ages.

In such a retrospect men and events naturally in their right perspective. It is more difficult to gage correctly contemporary tigators and results. Yet we would hardly he to point to Sir J. J. Thomson, of the Cave Laboratory, Cambridge, England, as a man name will stand on the records of the history o ence side by side with the greatest lights of the For his work far overtowers that of most of contemporaries, through the wealth of entirely and fruitful concepts which he has introduced modern science by ingenious experiment and a analytical and synthetic reasoning. It is thus he has given us an entirely new horizon by work on the corpuscular structure of the a which not only seems to reveal to us the true n of one of the most recondite forces inheren matter—chemical affinity—but which links into monious union such fundamental natural phenom as the mass-inertia of matter and the self-induc inertia of an electric charge.

The latest product of the fertile mind of t great genius seems destined to throw light on t darkest chapter in the field of modern chemistry. We have hitherto rested content with the study of chemical substances in that state in which we find them either before or after a reaction has taken place. To ask, what is the nature of matter during the intermediate stages of the process of chemical transformation, would until recently have been regarded almost as an impertinent question, except perhaps when it came from the lips of such an eminent chemist as Schonbein. Yet it is this question which, among others, Sir J. J. Thomson seems to have found the means of attacking by direct experiment. By measurements of the deflection of positive rays in a vacuum tube containing traces of various substances, it is possible not only to identify the elements and compounds present, but at the same time to determine their atomic and molecular weight. Furthermore, since the rays are registered within less than a millionth of a second after their formation, if chemical action is going on in the tube, it is to be expected that the method should disclose transient forms of matter intermediate between two chemical compounds, and thus shed light on the true nature of the process of chemical combination. And experiment bears out this expectation. In a tube originally charged with marsh gas, Sir J. J. Thomson has detected products of molecular weight 12, 13, 14, 15, and 16, corresponding to molecules having one, two, three, and four hydrogen atoms attached to the carbon atom. These represent the several intermediate stages in the formation of the complete marsh gas molecule, and we have here the first positive observation of such half-formed molecules.

It is probably not too much to say that these experiments, of which an illustrated note appears on another page of this issue, usher in a new era in the history of chemistry.

A Record Rainstorm in the Philippines

THREE great typhoons occurred in or near the Philippines last summer within a period of three weeks, viz., July 11th-17th, July 20th-27th, and July 30th-August 2nd.

The maximum rainfall occurred at Baguio—the official health resort of the Philippines. This place is 4,777 feet above sea-level and is normally one of the wettest spots in the islands, with an annual rainfall of 157.52 inches. Never before, however, had such a torrential downpour occurred here as on the four days July 14th-17th, 1911. The daily amounts, as recorded by a self-registering gage, were: 14th, 34.64 inches; 15th, 28.88 inches; 16th, 16.73 inches; 17th, 7.89 inches—a total for the four days of 88.14 inches!

For a period of four days this record had rarely been equaled in the history of meteorology. In average intensity, however, this storm does not quite equal one that occurred at Cherrapunji, in the Khasi hills of India—a place well known to meteorologists as the wettest spot in the whole world. Here during the five days June 12th-16th, 1876, fell a total of 114.14 inches of rain, distributed as follows: 12th, 30.45; 13th, 7.75; 14th, 40.80; 15th, 22.84; 16th, 12.30. It so happened that the maximum in *four* days was a little less than Baguio's record for a like period, viz., 88.69 inches.

Both these records were, however, eclipsed by that of a rainstorm that occurred in the mountains of eastern Jamaica, in November, 1909. At a place called Silver Hill the fall—if correctly measured—amounted to 135 inches in eight days, of which 114.50 fell in five days; 96.50 in four days, and 37.50 in two days. That these figures are at least approximately correct is shown by the records of surrounding stations.

Sir Joseph John Thomson, the Great English Physicist

The Originator of the Corpuscular Theory of Matter

By P. Phillips, D.Sc., B.A., Professor of Physics at the Royal Veterinary College, London

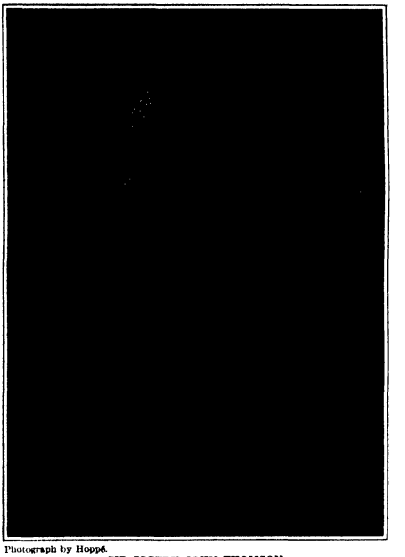
THE Cavendish Professorship at the University of Cambridge, England, of which Sir J J Thomson the present holder, is a post of honor to which his predecessors have lent no ordinary luster The first der of the office was James Clerk Maxwell, the found original genius who laid the foundations for modern electro-magnetic theory associated with name. The second Cavendish Professor was Lord leigh, whose measurements of the fundamental ntities of physics are among the most beautiful accurate experiments ever performed The third be called to the chair was Sir J J. Thomson, who s proved himself in every way worthy of his prede- ssors.

He was appointed while a young man in his twen- y-seventh year—a very early age for so responsible position—and his appointment was severely criti- cised by some of the older and more orthodox pro- fessors and tutors One well-known college tutor expressed the opinion that things had come to a pretty pass in the University when mere boys were made professors But the Board of Electors, including Sir William Thomson (Lord Kelvin), Prof G G Stokes and Prof G H Darwin, knew what it was doing, and the bold appointment has been amply justified by the continued advance of the Cavendish Laboratory and by the posi- tion which Sir Joseph has attained among his contemporaries

His early training Sir J J Thomson re- ceived at Owen's College, Manchester, where he was a student in 1876, and carried out some experimental work under Prof Bal- four Stewart. He thence proceeded to Cam- bridge, where he read mathematics until taking his tripos in 1880 From this time dates his connection with the Cavendish Laboratory, which was later to become so intimate and prolonged He was appointed to his present position in 1884 Perhaps when the lapse of time shall enable us to see things in a truer perspective, we shall con- sider that his greatest service to science has been the building up and inspiring of the center of research at the Cavendish Labora- tory. When he was first appointed there were not more than seven or eight students engaged in research, while at the present time the number has risen to about thirty, and the mass of work emanating from this scientific center is a splendid testimony to the enthusiasm and ability of the men gath- ered there

To give an account of any great man's work within the limits of a short article is always difficult, but it is unusually so in the present case, for Sir J. J Thomson is so continually overflowing with ideas, that his contributions to science are extremely varied and numerous It must suffice here to men- tion only a few of the larger pieces of work which he has carried out In 1881 appeared on the Adams Prize Essay a mathematical treatise on the vortex theory At that time the theory that atoms were vortices in the ether was very popular and sev- eral well-known names were connected with it, it had very little to recommend it, however, and since a bet- ter understanding of the phenomenon of the discharge of electricity through gases has given us more intimate information about the atom, the vortex theory has lapsed into a well deserved obscurity Neverthe- less the treatise formed a most valuable contribution to the general theory of vortices and showed some of the serious difficulties which would have to be over- come before the vortex theory of the atom could be accepted. Appropriately enough, one of Sir J J Thom- son's earliest experiments was the repetition of a measurement which strongly supported Maxwell's elec- tro-magnetic theory, namely, the determination of the ratio of the electro-static to the electro-magnetic unit of electricity. This was found to be equal to 3×10^{10}, a figure closely agreeing with the measured velocity of light expressed in centimeters per second This result is one of the conclusions which Maxwell derived from his theory, which thus received strong corrobora- tive evidence. Further confirmation was furnished in 1887 by the brilliant work of Hertz in demonstrating the existence of the electro-magnetic waves which Maxwell's theory foretold, and since then these waves have become a matter of every day talk by the devel- opment of wireless telegraphy The next important work published by Sir J J. Thomson was a series of papers published in the Philosophical Transactions of the Royal Society in 1886-1887 (and republished in book form in 1888) on "The Application of Dynamics to Physics and Chemistry" This work suggests a number of general methods of attacking chemical and physical problems which have proved most useful Their greatest value lies in the fact that they can be applied even where very little is known of the inner processes going on

A very important experiment was carried out in 1889, when Sir J. J Thomson devised a method of find- ing the specific inductive capacity of different sub- stances for very rapidly alternating electric forces This experiment was of considerable interest owing to the fact that Maxwell's calculations of the velocity of light in different substances, as dependent upon their



Photograph by Hoppé.

SIR JOSEPH JOHN THOMSON

specific inductive capacity, gave results considerably at variance with the observed values in certain cases Sir J J Thomson suggested that the discrepancy might be due to the fact that the specific inductive capacity of a substance for rapidly alternating electric forces, such as occur in light waves, differed from that found for steady electric forces in the usual way Experiment completely bore out this suggestion, and added one more link to the chain of evidence in sup- port of Maxwell's theory

After this followed a long series of experiments on the conduction of electricity through gases, which, along with the work of Schuster and others, has gone far to clear up our understanding of the mechanism of this complicated phenomenon In 1898 these experi- ments culminated in the discovery of the "electron," or as Sir J. J Thomson himself calls it, the "cor- puscle" This discovery has ushered in a new era in science, and has opened out a vast realm for new work upon the development of which some of the great physicists and mathematicians of the day have spent their best efforts It is unfortunately quite impossible within the scope of this article to give even a remote idea of the bearing of this work, only one or two points shall be mentioned with which the name of J J. Thomson himself is associated The picture of the atom which Sir Joseph would present to us is that of a large number of corpuscles, assembled together into a minute planetary system in which the corpuscles play the role of planets, revolving in concentric rings From considerations of the stability of such rings he has suggested an explanation of the existence of series or groups of elements with similar properties, thereby taking the first step in lifting the veil from the mystery of Mendeleeff's Periodic Table of the Elements Furthermore, by calculating the period of vibration resulting from various distortions of such rings of cor- puscles he has also suggested an explanation for the existence of series of lines in the spectra of different elements Since this conception of the atom was first put forward by Sir J J Thomson, it has been found that some elements are continually breaking down ejecting corpuscles, and giving rise to other elements as transformation products

Had the old idea of the indivisible atom still remained, this would have presented an almost insolu- ble problem, but with the new view of the atom it becomes perfectly simple Breaking down the atom is simply knocking off some of the outer rings of corpuscles leaving the inner rings intact and it is evident that such a process must be accompanied by the ejec- tion of corpuscles unless the rings which are knocked off reform themselves into a new system with exactly the same number of cor- puscles as are broken off the parent atom

Since that time Sir J J Thomson's main experimental and theoretical work has been concerned with the further working out of the problems presented by the conduction of electricity through gases, and with the con- stitution of the atom, but space does not permit of the presentation of his work in further detail

As a teacher he exerts a most inspiring influence upon his students making himself one with them and making them feel that he and they are engaged upon a common quest This sympathy with his pupils is probably the secret of his power but he has other qualities which are very valuable to his students His happy way of working things up from first principles and thus recalling the strong and weak points in any theory is most suggestive clears up a man's ideas and is most excellent preparation for future research work To observe his use of mathematics is an education in itself Sir J J Thomson is never led away into those pretty mathematical by-paths so dear to the heart of the orthodox Cambridge mathe- matical physicist He selects such mathe- matics as is required for his investigation and then marches straight ahead for his goal in a most convincing fashion He is always the physicist first and the mathema- tician after As leader of the research stu- dents at the Cavendish Laboratory Sir Joseph is the most approachable and helpful of men Although his personality dominates the laboratory yet there is splendid freedom from restraint and a wonderful encouragement to carry out research on any subject His visits to any par- ticular student may be somewhat spasmodic but this is quite in keeping with some other little eccentricities which are well known to all his students and which no doubt lose nothing in the telling At tea which he provides every afternoon in his room for all the research students J J as he is always called is perhaps at his best At this time all the gossip of the laboratory passes around and a story has to be a pretty tall one if he does not manage to cap it J J 's vigorous radical utterances are also very warmly dis- cussed, and not infrequently among the cosmopolitan collection of students the political discussions become both interesting and very animated

In this article the endeavor has been simply to show Sir J J Thomson as a man of science and the head of a famous laboratory Of the many honors showered upon him, culminating in the award of the Nobel prize in 1906, and the bestowal of Knighthood in 1908, and of his home life, nothing has been said, but the writer hopes that enough has been told down to make the reader join him in the wish that J J may be long spared to extend the limits of our knowledge in that section of natural science which he has made peculiarly his own, and in which he has labored with such brilliant success, giving to the world the priceless gift of his genius, and earning imperishable fame.



Chart showing the travel of Mars and Saturn across the heavens during equal periods of time, from June 1st, 1911, to March 31st, 1912.

The Motions of Mars and Saturn

Apparent Meanders of Two "Wandering Stars"

By Prof. S. A. Mitchell, Columbia University

IT needs but a casual glance to see that Mars is now the brightest object in the evening skies, it needs but a few evenings' watch even for anyone not acquainted with the stars, to note that Mars is a "wandering star," as the Greeks called it, a planet By making a diagram giving the position of Mars with respect to the neighboring stars, it will be easily seen, after a few nights' watching, that Mars is now moving toward the west among the stars The first week in December found Mars due south of the Pleiades and but a few degrees away from them It continues to move west only until the 29th of December, when it ceases its westward motion, becomes stationary, and then moves east at first slowly, and then with increasing pace

To the west of Mars is Saturn the wonderful, a never-ending source of pleasure to the amateur with his small telescope It, too, is changing its position among the stars, but with a satellite mien owing to its increased distance from us Saturn, too, at the present time, is moving toward the west, but it keeps on moving west until after the middle of January, 1912, when it becomes stationary, and then moves also to the east

The amateur who likes to watch the sky will find a great deal of profit from noting the motions of these two planets relation to the stars The accompanying diagram shows the motion of Mars from June 1st to March 31st and that of Saturn for the same interval, from the first of January to the end of March A glance will show that Mars 'retrograded,' or moved to the west from October 17th to December 19th, while Saturn moved backward on its path for a longer time, but through less angle, from 1911, September 2nd to 1912 January 16th Another glance will show that Mars has three times passed by the Pleiades first at the end of August when it was six degrees to the south of them, for the second time during the first week in December Toward the end of January will occur the closest of all three approaches, when it again passes to the south By following the diagram backwards, it will be seen that on August 15th, Mars and Saturn were very close together As a matter of fact on August 16th at 11 P M Mars and Saturn were separated by only twenty-one minutes of arc, which is an angle equal to two-thirds of the moon's diameter, Mars being north of Saturn On the same night, a few hours later, the moon was in the same part of the sky, passing to the north but four degrees away This interesting conjunction has been magnificently portrayed by the accompanying photograph taken with the six-inch Bruce telescope by Prof. E E Barnard of the Yerkes Observatory This was taken on the morning of August 17th at 3 14 o'clock with an exposure lasting twenty seconds It is a remarkable photograph in that it shows the dark portion of the moon in the last quarter illuminated by "earth shine" The planet nearest the moon is Mars.

After the date of this photograph, Mars was moving rapidly eastward while Saturn soon slowed down and then moved westward By October 17th, the planets were separated by 25 degrees, when the change in the motion of Mars again began to lessen the distance They will be nearest each other about New Year's, after which the eastward motion of Mars will again cause the distance to increase

As everyone knows, the apparent motion of the planets is caused by the motion of the planet about the sun combined with that of the earth The relative motion of Mars, for instance, may be correctly represented by supposing that it has two motions, one its own motion, and superposed on this another, equal in

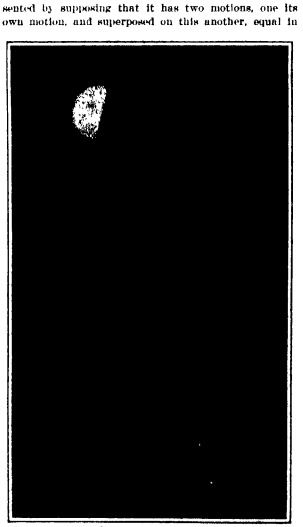


Photo by E E Barnard

Conjunction of Mars, Saturn, and the Moon, 1911, August 16, 15h. 14m. C. S. T.

magnitude to that of the earth's motion about the sun, but in the opposite direction This simple fact explained in detail in every text book on astronomy need not further be elaborated here

A Type of High-intensity Primary Cell

By Dr. Alfred Gradenwitz.

A NEW high-intensity primary cell invented by H. D. P. Huizer of The Hague owes its high efficiency mainly to the fact that the carbon and zinc are located as closely to each other as possible, the carbon having a grooved surface through which the ions can be discharged easily and rapidly. Wherever these ions after their discharge result in polarization, the apparatus is so designed as to produce immediate depolarisation by chemical and mechanical effects, so that the ions coming afterward may be free to discharge on the poles. The high current density and short distance between the carbon and zinc also warrants a uniform and economical dissolution of the metal. At a recent test the electromotive force in open circuit was found to be about 1.95 volts and the working tension with weak currents (up to 1 ampere [0.065 per square inch] per square decimeter electrode surface) about 1.8 volts, with high-intensity currents (up to 5 amperes [0.32] per square inch) about 1.6 volts and with maximum current densities (up to 0.65 amperes per square inch) about 1.4 volts Current rushes and even short-circuits (up to about 2 amperes per square inch) with tensions reduced in proportion, were found to exert no objectionable action on the cell; the internal resistance was very low (down to 0.01 ohm)

Ten incandescent lamps of a total of 26-27 candlepower could be fed permanently with a single cell. The consumption of zinc with diluted sulphuric acid was found to be 1.7 grammes per ampere-hour (the theoretical electro-chemical equivalent being, of course, 1.22 grammes per ampere-hour). The useful current effect was found to be 70 per cent, so that 1 kilogramme of zinc (and 1½ kilogrammes of sulphuric acid) will be amply sufficient to develop 1 horse-power-hour, the current expenses only being about 16 cents, viz., 1/10 of that of ordinary primary cells The depolarising capacity is so remarkable that one-fourth minute suffices for the cell to recover its maximum tension after a short-circuit.

It will be readily understood that these results constitute a remarkable advance over primary cells so far in general use. While the output of common stationary storage battery cells for each kilogramme of their own weight is 10-15 watt-hours and that of the portable accumulators 25-30 watt-hours, the new cells allow outputs of 30-50 and those designed for transportation operation as much as 100 watt-hours. In connection with a special type of cell the inventor is even able to insure 200 watt-hours for each kilogramme of cell weight.

In a test of an electric vehicle equipped with the new cells the current expenses worked out at about 3 cents per ton mile. With a single supply of zincs (about 330 pounds) and several re-fillings of acid, the vehicle covered a distance equal to that between the Hague and Paris (about 300 miles) at an average speed of 18 miles per hour. The new cell would moreover seem to lend itself to the propulsion of electric cars and airships.

The new cell is made in two different types. In connection with the tests described above concentric cylinders were used. However, in order even further to reduce the consumption of zinc, a special type of "parallel" cell has been designed in which the carbon surface is likewise increased to a maximum by ribs, though not in the shape of cylinders but of flat plates. The zinc, so far from constituting a homogeneous mass, assumes the form of minute disks performing an automatic motion by which their distance from the carbon is kept constant, insuring a uniform work.

Powerful Electromagnet for the Use of Oculists

A Convenient Form of Apparatus for Extracting Iron and Steel Splinters

By C. Van Langendonck

...ne electromagnet designed for the use of oculists ... by Dr. Haab, director of the Zurich eye clinic, and ...wn in the accompanying photographs, is the most ...werful and efficient apparatus of this kind in exist... According to Dr. Haab, the principal require... of such an instrument are the following:

1. The magnet must be capable of developing very ...t tractive force.

2. It must be placed horizontally, and its circuit ...t be made and broken by the operation of a pedal.

3. The working pole must have a form adapted to ... peculiar function and its dimensions must bear the ...per relation to those of the coil.

The first condition is very important. The small ...ectromagnets which are commonly used by oculists ...ften fail at the critical moment, owing to their lack ...f adequate magnetic strength, and thus endanger the ...uccess of the operation.

The method of making and breaking the circuit by ...the foot of the operator possesses great advantages, ...because it leaves both hands free for the control of ...the eye and body of the patient, and makes it unneces...sary to remove the magnet in order to stop its action ...This last point is exceedingly important for, even with ...the most perfect suspension, it would be impossible ...to withdraw the heavy electromagnet from the eye ...quickly enough to prevent the iron filing or other ...foreign substance from being drawn into a region ...where its presence is not desired. When the circuit ...is opened and closed by a pedal the magnet need not ...be suspended.

Dr. Haab regards the suspension method not only as ...impracticable for the heavy magnets which he em...ploys, but as incorrect in principle. His experience ...proves that it suffices to support the magnet in such ...a manner that its axis can be turned to any direc...tion in a horizontal plane.

In regard to the form of the working pole, it is ...obvious that its action will be weakened in propor...tion to the extent to which it protrudes from the coil. ...It must not, however, be so short that the coil in...terferes with the view of the field of operation, as is ...the case in some of the newer large electromagnets.

The magnet is of the bell form. The working pole ...is a cone of 90 degrees, and this end of the coil is ...tapered sufficiently to give the operator a clear view ...of the field up to the tip of the magnet pole. Four ...pointed tips accompany each apparatus.

The idle pole is expanded into the form of a bell ...which covers and protects the greater part of the ...coil. This construction possesses the additional ad...vantage of restricting the escape of lines of force to ...one side and diminishing the area of the external ...magnetic field.



A set of pole points.



Foot-controlled electromagnet.

The magnet is mounted on a cast iron pillar, in such a manner that it can easily be turned in any direction. The pillar is hollow and is provided with castors, so that the apparatus can be moved without difficulty. The axis of the magnet is about four feet above the floor. At a little more than half this height a shelf is attached to the pillar for the purpose of supporting the patient's arms and keeping his head motionless during the operation.

The base of the pillar contains the electric switch which is closed by depressing a pedal and is thrown open by a spring the instant the foot is raised. A special device protects the contacts from injurious sparking. The current-density in the coil is very small in comparison with its density in other electromagnets. Hence very little heat is developed—a condition essential to permanent efficiency.

In tractive power Haab's electromagnet stands at the head of all known electromagnets used by oculists. At a distance of 1/2 inches, for example, it exerts a pull more than twice as strong as that of the largest Volkmann magnet.

The electromagnet is designed for use on direct current circuits of 60 to 300 volts, but it can be employed on alternating, uniphase or triphase circuits with the aid of a suitable transformer. The maximum power required is about one kilowatt. The total weight of the apparatus is about 286 pounds.

This apparatus, although designed primarily for the use of oculists, is admirably well adapted for the extraction of iron filings and splinters, hammer scale, etc., from wounds in any part of the body. Hence it may advantageously be installed in the hospital rooms of all large mining and metallurgical establishments. Experience shows that the magnets now employed in these rooms are used as often on hands and arms as on eyes. Wounds incurred in planing iron are often filled with fine splinters of iron. The removal of these splinters singly with pincers or needles is a tedious and painful operation, but all of the iron or steel particles can be extracted quickly by means of a powerful magnet.

A Seismograph in a Coal Mine

NATURE states that a seismograph has recently been installed in the Tunnel Colliery, at Nuneaton, for the purpose of ascertaining whether the apparently inexplicable falls of coal and roof in mines have any relation with the occurrence of earthquakes. Aside from the practical object in view, a comparison between the records of this instrument and those of instruments on the surface is likely to be of much scientific interest.

Frost Fairs on the Thames

LONDON winters are more remarkable for dismal drizzling rain and impenetrable fog than for snow and ice; but about half a dozen times in the last three hundred years truly arctic conditions have prevailed in that metropolis, and the River Thames has been frozen over so firmly that men and horses could go upon it. Each of these periods has been the occasion of a "frost fair"; booths have been erected on the ice; printing presses set up, various sports and games indulged in; and the whole population has joined in celebrating the rare event.

The first great frost fair was held in January, 1608; but the most famous of all was that of 1683-4, which lasted from the beginning of December to the 5th of February. Evelyn gives the following description of this fair in his "Diary": "The frost continuing more and more severe, the Thames before London was still planted with boothes in formal streetes, all sorts of trades and shops furnish'd and full of commodities, even to a printing presse, where the people and ladyes tooke a fancy to have their names printed, and the day and yeare set down when printed on the Thames: this humour tooke so universally, that 'twas estimated the printer gain'd £5 a day, for printing a line onely, at sixpence a name, besides what he got by ballads, etc. Coaches plied from Westminster to the Temple, and from several other staires, to and fro, as in the streetes, sleds sliding on skeates, a bull-baiting, horse and coach races, puppet-plays, and interludes, cookes, tipling, so that it seem'd to be a bacchanalian triumph, or carnival on the water." King Charles II. and his family visited the fair, and had their names printed on a quarto sheet of Dutch paper, which is still extant.

During the frost fair of January, 1716, it is recorded that an uncommonly high spring tide, which overflowed cellars on the banks of the river, raised the ice fully fourteen feet, without interrupting the people in their pursuits.

Similar fairs were held in 1740, 1788-9, and 1814. The last was one of the gayest and most animated of these events, though it lasted only four days.

Meeting of the American Association

THE sixty-third meeting of the American Association for the Advancement of Science will be held in Washington, December 27th to 30th, 1911, under the presidency of Prof. Charles E. Bessey, of the University of Nebraska. In conjunction therewith will be held the tenth of the "convocation week" meetings of affiliated societies, viz.: American Anthropological Association, Astronomical and Astrophysical Society of America, Society of American Bacteriologists, American Society of Biological Chemists, Botanical Society of America, American Chemical Society, American Civic Alliance, American Economic Association, American Association of Economic Entomologists, Entomological Society of America, American Fern Society, American Folk-Lore Society, Association of American Geographers, Geological Society of America, American Federation of Teachers of the Mathematical and the Natural Sciences, American Home Economics Association, Society for Horticultural Science, American Association for Labor Legislation, American Microscopical Society, American Nature-Study Society, Paleontological Society of America, American Physical Society, American Physiological Society, American Phytopathological Society, American Psychological Association, Sigma Xi, American Sociological Association, American Statistical Association, Sullivant Moss Society, Southern Society for Philosophy and Psychology.

The administrative headquarters of the meeting will be at the New Willard Hotel where all members will register, beginning at 9 o'clock, December 27th. The opening general session of the Association will be held at the U. S. National Museum at 8 P. M., December 27th. It is expected that an address of welcome will be given by the President of the United States and the retiring president of the Association, Dr. A. A. Michelson, will give his annual address, the subject being "Recent Progress in Spectroscopic Methods." The various sectional meetings begin at 10 A. M., December 27th. The programme of entertainments includes an exhibition cavalry drill at Ft. Myer on the afternoon of December 28th, and an informal reception at the Corcoran Art Gallery the same evening.

The Australian Antarctic Expedition

DR. MAWSON'S projected antarctic expedition has secured a suitable vessel—the "Aurora," built at Dundee in 1876—and the preparations are proceeding rapidly. As we have previously stated the object of this expedition is the thorough exploration of a portion of Antarctica, rather than a dash for the pole. It is announced that an aeroplane forms part of the equipment.

The Scientific American-Gould Prize

A COPY of the rules governing the competition for the flying machine prize of $15,000 offered by Mr. Edwin Gould under the auspices of the SCIENTIFIC AMERICAN will be found in the current issue of the SCIENTIFIC AMERICAN SUPPLEMENT.

Abstracts from Current Periodicals

Phases of Science as Other Editors See Them

A New Method of Chemical Analysis

IN a lecture delivered before the Royal Institution in the spring of this year, and reported on in *Nature*, Prof. J. J. Thomson made a communication which will mark one of the chief scientific achievements of the year. Sir Joseph's connection with the corpuscular theory of matter and his heroic attacks upon the most fundamental problems of chemistry, such as are presented to us in the periodic table of the elements, is known to our readers. Until recently J. J. Thomson's theory of the atom, while representing with remarkable truthfulness certain of the chemical properties of matter, was still largely theory. The work reported on in the lecture referred to above may be said to represent the first and most important step toward the realization by experiment of some of the conjectures which flow from the hypotheses advanced by the great physicist some years ago. The experimental arrangement followed is to project positive rays through a vacuum tube containing traces of the materials under examination, and to subject the rays to the influence of a magnetic and electrical field, disposed at right angles to one another. Under these circumstances, the rays is deflected and from the nature of the deflection it is possible to determine the mass of the molecules or atoms within the tube. The course of the ray is recorded photographically, and if several substances are present, a number of separate curves are obtained, forming a "positive ray spectrum." Our first illustration shows the spectrum of nitrogen prepared from air. Measurements on this photograph show that the atomic weights of the carriers producing the spectrum curves were as follows:

Positive	Negative
1·00 $H+$	1·00 $H-$
1·99 H_2+	11·20 C
6·80 $N++$	15·20 $O-$
11·40 $C+$	
13·95 $N+$	
28·10 N_2+	
39·00 $Arg+$	
100·00 $Hg++$	
198·00 $Hg+$	

The symbol $H+$ denotes that the carrier is an atom of hydrogen with one charge, H_2+ that it is a molecule of hydrogen with one charge, $N++$ that it is an atom of nitrogen with two charges and so on. A case of the highest interest is the positive ray spectrum of marsh gas (Fig. 2). The remarkable feature in this is that it discloses the presence, not only of marsh gas, CH_4, but also of substances having molecular weights, 12, 13, 14, 15, thus corresponding to bodies C, CH, CH_2, CH_3. With regard to these Sir Joseph remarks: "If I am not mistaken, this is the first occasion when the atoms CH, CH_2, CH_3 have been observed in the free state." The significance of this discovery to chemistry can hardly be over-estimated.

Schonbein remarked years ago—though the same words have held true until practically the present day—Shakespeare says that there are more things in heaven and earth than are dreamed of in philosophy.' Thus, presumably, intermediate between the state in which two portions of matter exist after completion of chemical combination and the state in which they previously existed separately, there is a series of transition states of which the chemistry of to-day knows nothing." It appears that now Sir J. J. Thomson has given us the key that opens the entrance to this realm of natural phenomena which, until now, has been practically a sealed book to us.

An Important Step in the Problem of Television

THE *electro-telescope* or "electric eye," invented by Prof. Rosing of the St. Petersburg Technological Institute, is said by Prof. Ernest Ruhmer himself a diligent and successful worker in this field, to mark an important step toward the practical solution of the problem of television. Prof. Rosing's ingenious apparatus, which has already been mentioned in the SCIENTIFIC AMERICAN SUPPLEMENT of June 17th, 1911, is described as follows by Prof. Ruhmer in a recent issue of *Die Umschau*:

The transmitting apparatus (Fig. 1.) is connected with the receiving apparatus at the distant station (Fig. 2) by six wires. Instead of the selenium cell used in most systems for transmitting gradations of

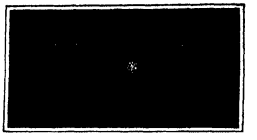


Fig. 1.—Positive ray spectrum of nitrogen.

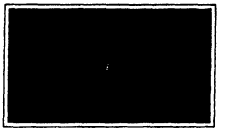


Fig. 2.—Positive ray spectrum of marsh gas.

light and shade, Prof. Rosing employs a photo-electric cell, which reacts much more quickly. This photo-electric cell F (Fig. 1) consists essentially of a glass globe, filled with rarefied hydrogen or helium and with its lower hemisphere coated internally with an amalgam of sodium or potassium, which is connected with the negative pole of a galvanic battery, the positive pole of which is connected with a platinum electrode which is fused through the glass at the top of the globe. In these conditions no current passes long as the globe remains in darkness. If, however, the amalgam which forms the cathode is illuminated, the rarefied gas is traversed by a current, the strength of which has been found by Righi and Stoletow to be directly proportional to the intensity of illumination and to follow exactly every variation of the latter.

In Prof. Rosing's transmitting apparatus (Fig. 1), an image of the object or picture MN is thrown by the lens L and the two polyhedral mirrors A and B, upon an opaque screen having a small aperture a, which is placed in front of the photo-electric cell F. The mirrors A and B rotate on mutually perpendicular axes with different velocities. The image is displaced in the plane of the drawing by the mirror B and in a direction perpendicular to that plane by the mirror A. By the combined action of the two mirrors the image is moved across the opaque screen in a series of parallel paths, so that every part of the image falls successively on the aperture a and illuminates the photo-electric cell F within a small fraction of a second.

The picture is reproduced at the receiving station by means of a Braun's tube. This device is an evacuated glass tube (R, Fig. 2) containing two electrodes, A, K, which are connected with the poles of an induction machine or other source of electricity of high potential. The cathode K emits cathode rays which fall upon a diaphragm through which a small pencil of the rays passes to a screen P. This screen is coated with potassium tungstate which is excited to fluorescence by the impact of cathode rays, so that a small luminous spot is formed at the point where the pencil of rays strikes the screen. Cathode rays can be deviated by electrostatic and by magnetic force, and Rosing makes use of both agencies. The Braun's tube is surrounded by two pairs of electromagnets, s t. One pair of electromagnets deviates the pencil of cathode rays in the plane of the drawing, the other in the perpendicular direction. Each of the mirror-drums A and B at the transmitting station (Fig. 1) carries a number of magnets which, as the drums revolve, generate electric currents in fixed coils, p p' p'' and q q' q'', near which they pass. Each of these two groups of generating coils is connected by two line wires with one pair of the electromagnets which deflect the pencil of cathode rays at the receiving station. In each case the current, the magnetic field which it produces, and the deflection of the rays are proportional to the angular displacement of the mirror-drum, which also determines the position of the reflected image at the transmitting station. The pencil of cathode rays, therefore, moves over the fluorescent screen in exact accordance with the movement of the image. The brightness of the fluorescent spot which thus reproduces the image at the receiving station is regulated by the condenser plates C C (Fig. 2) which are placed inside the Braun's tube and connected, respectively, through two line wires, with the positive pole of the battery at the transmitting station and with the platinum electrode of the photo-electric cell F (Fig. 1), while the negative pole of the battery is connected directly with the amalgam coating of the cell.

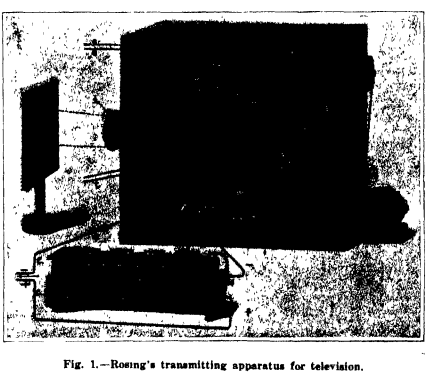


Fig. 1.—Rosing's transmitting apparatus for television.

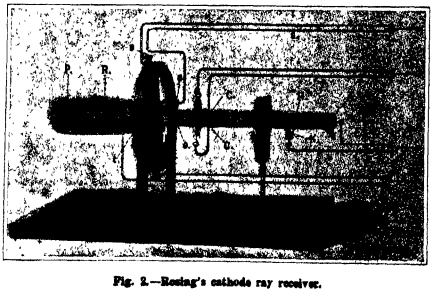


Fig. 2.—Rosing's cathode ray receiver.

In these conditions the strength of the electrostatic field between the condenser plates is proportional to the intensity with which the photo-electric cell is illuminated. The pencil of cathode rays which passes between the plates is correspondingly deflected so that a larger or smaller part of it is enabled to pass through a second diaphragm (o, Fig. 2) which is interposed between the condenser and the fluorescent screen, the diaphragms being so placed that no rays fall on the second one when the condenser carries no charge. Hence the brightness of the fluorescent spot which moves over the screen at the receiving station is always proportional to that of the corresponding point of the original image, and as the entire operation is repeated many times in a second, the fluorescent screen presents to the eye, in consequence of the persistence of retinal impressions, a motionless and exact monochromatic reproduction of the original picture.

Science

[illegible] Research in Spitsbergen.—A German research institution has been established in Spitsbergen, and Drs. Rampp and Wagner have begun a year's work there in aerology and geophysics. A unique interest attaches to the observations of the upper air that will be made throughout the polar night.

Aerial Post in Italy.—The latest country to try an aerial postal service is Italy. The Italian aeronaut Mistro recently carried a sack of mail between Bologna and Venice postoffices in a Deperdussin aeroplane, covering the distance of 101 miles in 1 hour and 28 minutes.

The Utilization of Grape Pips.—The utilization of by-products is one of the most striking characteristics of modern industry. A recent example is found in Italy, where a means has been discovered to turn to account the hitherto worthless pips of the grapes used in wine-making. Oil is now extracted from them on a commercial scale by a process of direct heating with tetrachloride of carbon. The latter is obtained in abundance in Italy in the preparation of electrolytic soda.

Nobel Prize Winners.—On December 10th, King Gustav of Sweden presented the Nobel Prizes, with the exception of the peace prize, to the winners. Mme. Marie Sklodowska Curie personally received the prize for chemistry, Prof. Wilhelm Wien of Wuerzburg University the prize for physics, and Prof. Allvar Gullstrand of Upsala University the prize for medicine. The Belgian Minister received the prize for literature in behalf of Maurice Materlinck, who was ill. The Nobel Prizes each amount to nearly $40,000.

Upper-air Research in Canada.—The Meteorological Service of Canada has been making observations of the upper air with sounding balloons since February last, and has achieved some excellent results. Of sixteen balloons sent up, eight have been recovered to the present writing. The altitudes attained have varied from 11.2 to 23.2 kilometers (about 7 to 14 miles). The isothermal layer was found at an average height of 13 kilometers (8.1 miles). The lowest temperature recorded was 70 deg. below zero Cent. (94 deg. below zero Fahr.) at an altitude of about 8.7 miles.

A Meteorological Tea.—In connection with the Washington meeting of the American Association for the Advancement of Science an informal gathering is to be held at the Weather Bureau, Thursday afternoon, December 28th, from 3 to 7, when "The Relation of Meteorology to Other Sciences" will be discussed, and the visitors will be given an opportunity of inspecting the installations and work of the bureau. Eminent representatives of several sciences have been invited to make brief addresses on the meteorological bearings of their several fields of work. The promoters of this undertaking hope that a similar *conversazione* or tea may become a permanent feature of the association's annual meetings, at which meteorology has not heretofore been represented in any definite way.

The Bend of the Brahmaputra.—We recently referred in these columns to the remarkable fact that the great bend of the Brahmaputra—where the river turns southward, in Tibet, and begins its course toward the Bay of Bengal—remains to this day a geographical question-mark for a distance of nearly a hundred miles. Probably no one bit of the earth's surface, with the exception of the poles, has been the object of such keen curiosity on the part of geographers. It is now reported that the British authorities in India are preparing a punitive expedition against the savage Abors—whose hostility has been the chief obstacle to the exploration of the region in question, and whose latest misdeed was the murder of Mr. Noel Williamson and Dr. Gregorson. In the course of this expedition it is almost certain that the unknown stretch of the river will be explored, and the identity of the Tibetan Tsangpo with the Brahmaputra will be fully established.

The Canton-Hong-kong Railway.—The American consul general at Hong Kong reports the formal opening on October 4th of the Canton-Hong-kong Railway. The British section, which was built by the colony of Hong-kong and opened about a year ago, extends from Hong-kong or Kowloon to Sam Chun, about 22 miles; it is tunneled through many mountains and cost $5,164,710. The Chinese section, built by the Chinese government with money lent by the colonial government of Hong Kong, extends 89 miles from Sam Chun to Canton, and cost $6,510,080. The freight cars were mostly imported from England, but the passenger cars were made in the shops of the Railway Administration of North China, except those of the British section, which were made in Hong-kong. Some of the rails are from Chinese works at Hankow. In fact, a noteworthy feature of this and other recently built railways in China is the large amount of the equipment that is Chinese-made.

Electricity

Meat Shrinkage in Electrical Cooking.—A recent consular report calls attention to the tests at the London Electrical Exposition which demonstrated that the shrinkage of meat when cooked in a coal range is somewhat greater than that of the same meat cooked in a gas range, and considerably more than when cooked in an electric range. A leg of mutton weighting 8 pounds and 8 ounces showed a shrinkage of 2 pounds and 11 ounces when cooked in the coal range, whereas a leg of mutton weighing 9 pounds showed a loss of 1 pound and 4 ounces when cooked in an electric oven. The shrinkage for the gas oven was 2 pounds and 4 ounces on an 8-pound leg of mutton.

Helium Tubes as Light Standards.—It was brought out at the meeting of the Philosophical Society of Washington last November that the Bureau of Standards has been experimenting with various gases, with a view to obtaining a vapor lamp which may be used as a light standard. The best gas was found to be helium. The light produced in the helium tube is a yellowish white, similar to that of the Hefner flame, and of carbon filament lamps. Other gases which seemed promising were dioxide and sulphur dioxide, but these were rejected, owing to the fact that the light they emitted was too white. The helium tube shown by experiment to be best adapted for the purpose was 7 centimeters long, with a bore of 2 millimeters and a wall 2 millimeters thick. The tube was provided with terminal bulbs 35 millimeters in diameter, containing aluminium electrodes 25 millimeters in diameter. With this form of tube the density of the gas did not affect the light over a range of 3 to 8 millimeters pressure, and a practically constant light was emitted, even though the voltage and the frequency of the current varied considerably.

Paris Suburban Railroad Electrification.—It will be remembered that a project is on foot for electrifying the whole of the Paris suburban railroad lines belonging to the West State system, and the expense of carrying this out is estimated at nearly $30,000,000. No definite decision has been made as to what electric method will be employed for running the trains. The plans left over from a former commission called for the use of a line somewhat resembling the Metropolitan subway, and the new commission is engaged in bringing these up to date. This method of looking at the subject is criticised, however, by outside engineers, as they claim that the suburban lines should not be operated on the same plan as the subway by direct current motors, but that such roads should be considered as part of the trunk lines and would be better run on the single-phase system, such as is adopted by the Prussian, Swiss and Swedish governments and elsewhere. The advantage would be felt when it comes to extending the suburban lines, as this can be done indefinitely, while it would be difficult on the present plan. Besides, there would be no need for substations placed along the road. As there are 130 miles of suburban track, this would require quite a number of such stations.

Around the Globe by Wireless.—A project is being developed in France by which it is expected to send wireless messages around the globe, and this will be done by erecting stations in the French colonies. A commission has already been formed by the colonial department to carry out the enterprise, and Commandant Ferrié, the well-known wireless engineer who is at the head of the Eiffel Tower plant is in charge of the technical matters. Not more than $2,500,000 will be required for the twelve wireless stations called for by the programme, and it should be completed in about two or three years. Messages sent out from the Eiffel Tower at Paris will first reach the posts erected at Dahomey and Timbuctoo in west Africa. Thence they will cross the continent to the coast of the Red Sea at Djibouti or else proceed southeast to Madagascar. Either of these two posts can then send messages across the Indian Ocean to the post in India at Pondichery, whence they will be transmitted to the eastern coast of Asia at Saigon. About 5,000 miles separate this point from the island of New Caledonia, to the north of Australia, and this can be covered by a high-power station. The Pacific will then be crossed by stations at Tahiti and the Marquise Islands. It then remains to cross over Central America so as to reach Martinique in the Atlantic, then crossing the ocean to the west African coast at Rufisque. From here the circuit around the globe will be completed to Paris. The main object of the French enterprise is to connect the capital with all the colonies spread over the earth's surface and also to connect all the colonies among themselves. This will give a great advantage over the present telegraphic cables, which frequently break and need repairs and are often owned by foreign companies. It is interesting to note that the waves sent from the Pacific to the Atlantic posts will cross over the region of the Panama Canal.

Aeronautics

Moving Pictures from an Aeroplane.—The photographer who accompanied Robert G. Fowler on his coast to coast trip for part of the way, has been taking motion pictures from Fowler's aeroplane. It is stated that a special apparatus was employed to overcome the vibration caused by the aeroplane engines. We are not informed whether the films are a success.

Vedrines' Falls.—On December 8th, Pierre Vedrines fell with his monoplane at Moranmes from a height of 75 feet. His collar bone and right arm were broken. This would not be so serious were it not for the fact that grave internal injuries were also sustained, with the result that some concern is expressed whether or not Vedrines will survive the accident. He had only just recovered from a very bad fall at Hericourt on September 13th, in which two of his ribs were broken. Vedrines is one of the crack flyers of France.

An Adverse Wright Decision.—The suit brought by the Wright Company against Claude Grahame-White for damages resulting from an alleged infringement of their patent has been decided in Mr. Grahame-White's favor by the United States Court, Judge Hand presiding. The judge said: "It is well settled by numerous authorities that the word 'damages' in the section includes profits. Therefore, under the complaint as it now stands the complainant cannot recover upon the accounting any damages or profits prior to the bringing of the suit. The question of costs is reserved for final action."

Final Award of the Statue of Liberty $10,000 Prize.—At a meeting of the International Aeronautic Federation in Rome last month Grahame-White was finally awarded the $10,000 prize for the race from Belmont Park to the Statue of Liberty and back, which was flown during the meet at Belmont Park a year ago. The two other competitors, the late John B. Moisant and Count de Lesseps, were each declared to be the winner of this prize at one time or another, but Grahame-White's protests that Moisant had not flown one hour continuously at the meet in accordance with the rules and that Count de Lesseps fouled a pylon were sustained.

The Aeronautic Shows in Paris and New York.—The Third International Exhibition of Aerial Locomotion opened in the Grand Palais in Paris on December 10th. The great advance made in aviation during the past year was apparent from the great number—about two score—of excellent aeroplanes on view in the main hall, as well as from the large number of makers of accessories who exhibited in the galleries. All told, about 350 makers of aeroplanes and accessories had their product on exhibition. With the exception of one Englishman and two Germans, all the exhibitors were French. Fifteen different makes of aviation motors were on view. Many lectures by men prominent in aeronautics will be given during the fortnight the exhibition is open. New York's first big aeronautic show is to be held next May under the auspices of the Aero Club of America.

An Aerial Taxicab.—Blériot has built for Henri Deutsch de la Meurthe a veritable aerial taxicab. The machine has a body which looks for all the world like that of a taxicab body. The passengers enter by a side door and view the landscape below through mica windows. Pneumatic cushions protect the passengers in rough landings. The pilot sits in front of the machine like a true chauffeur, and controls the machine with regular Blériot *clocks* and foot tiller. There is even a speaking tube to facilitate communication between the passengers within the taxi and the chauffeur. The elevator has been placed in front instead of in the rear. A 100-horse-power Gnome engine is mounted on top of the cab and with it the fuel tanks. The spread of wing is 43 feet from tip to tip, and the over-all length is 46 feet. Ready for flight, without passengers, the aeroplane weighs 1,540 pounds.

Recent Aeroplane Fatalities.—On December 2nd Tod Schriver, one of the first fliers to be taught by Curtiss, was killed by a fall at Ponce, Puerto Rico. He had been flying in a strong wind about 10 minutes and was descending in order to alight when he made a sharp turn and at the same time accidentally accelerated his motor. The result was that the biplane tipped still more and then slid sideways to the ground. It struck on one end in a cane field, and Schriver was so badly hurt that he expired soon after. The same day Lieut. Baron von Eteeting Lorinchoven fell and was killed at the Doberitz military aviation field in Germany, while on the 3rd last another German aviator, Herr Reeb, met with the same fate while flying across country from Munich to Nuremberg. Three days later Hubert Oxley and his passenger Wobss fell to their deaths at Filey, England, while flying a powerful Blackburn monoplane. On December 13th Lieut. Charles Lantheaume, a French military aviator, was killed by a fall at Melun just as he arrived after a successful flight from Etampes.



View in the sorting room of an artificial silk factory.

Artificial Silk—A Textile Marvel

Making Lustrous Yarn from Wood Pulp

By H. W. Ambruster

"YOU can not make a silk purse out of a sow's ear" is a familiar quotation. Its use, however, will probably be discontinued by the next generation, as silk is now made artificially by mechanical means out of material which, if not a product of the pork packer's slaughter house, is about as low down in the aesthetic scale. Wood pulp—made from spruce trees, or in fact from any variety of wood—is dissolved in various chemicals and the solution is spun into a beautiful lustrous yarn, the sheen and gloss of which outrivals the most costly cocoon silk. An industry of enormous proportions has been built up with the development of this new product, factories in Austria, France, Germany, and more recently in England turning out many thousands of pounds of the yarn every day.

And at the present time an enormous plant is just starting to manufacture in this country (near Chester, Pa.) making the same product. In certain textile lines, notably the braids and trimmings for women's dresses and hats and in knitted neckties, the artificial silk or wood silk as it is sometimes called has practically replaced the real article. Probably ninety per cent of the braids and passementerie now manufactured are wood silk, though the retail consumer seldom realizes this fact. The yarn is also used largely in tapestries and curtains and dress goods, while ribbons and various other fabrics supply an almost limitless field which is being invaded by this latest triumph of man's ingenuity. True synthetic silk has been made by chemists, it is claimed, the product of the cocoon being absolutely duplicated in every respect, chemical and physical, but this achievement, successful as it was as a scientific laboratory experiment, had no commercial value on account of the enormous cost of production.



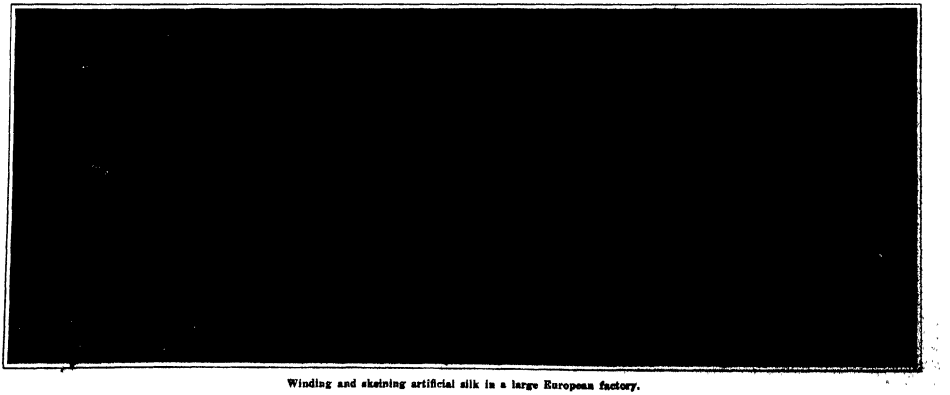
A, B, D, are made entirely of artificial silk. C is a dress fabric made of worsted and artificial silk.



On the right is shown some raw cotton seed fiber; on the left, pure cellulose made therefrom; in the center, some spruce pulp.

A Frenchman, Hilaire de Chardonnet by name, was the first to make wood silk on a commercial basis, and although he is now very wealthy, it is said that he went into bankruptcy several times before he was finally successful. Chardonnet used a solution of nitro-cellulose in which sulphuric ether is the solvent, and several of the largest of the European mills are still using his process or modifications of it. The second process to be developed commercially was based on the use of what is known as the cuprammonium solution of cellulose in which copper salts and ammonia are the solvents. A third cellulose solution was discovered about twenty years ago by the English chemists, Cross and Bevan, and "viscose," as it is called, is now rated as the best of them all for making the artificial filaments.

The nitro-cellulose process depends on the use of the same solution that is used for making celluloid and guncotton and the first yarn made from it was highly explosive and dangerous to handle being therefore impracticable as a commercial article. After numerous failures, however, the French inventor discovered a way of denitrating the finished yarn and thus made it no more explosive or inflammable than so much cotton or paper. A German chemist by the name of Lehner made further improvements in the Chardonnet process and now there are great factories at Besançon in France, at Frankfort, Germany, and Zurich, Switzerland, where thousands of pounds of Chardonnet silk are manufactured daily. The nitro



Winding and skeining artificial silk in a large European factory.

MAKING SILK FROM WOOD PULP

...loose solution, made by dissolving the wood pulp in ...r, is squirted through exceedingly fine jets or ...illary tubes of glass. As it emerges either into a ...ter bath or into the air the cellulose originally held ...solution partially solidifies and a gummy filament ...the result. A number of these filaments, 12 to 20, ...e gathered together and twisted into a yarn in the ...me way that cocoon silk threads are spun or thrown ...gether. The artificial silk threads, while still soft ...d gummy are then stretched on drums or reels and ...ried, during which process they take on the beautiful ...ster so eagerly sought for by silk manufacturers.

The process of making viscose silk starts from an ...lkaline solution of cellulose. The wood or cotton ...lp is treated with caustic soda until a mercerization somewhat similar to the chemical reaction in ...mercerising cotton yarn has taken place. But the decomposition is carried much farther in making viscose. Bisulphide of carbon is then added to the partially decomposed pulp and the fibrous nature of the ...aterial disappears, altogether leaving a gummy mass which passes into a perfect solution when weak caustic liquor is added. For spinning the viscose solution somewhat different apparatus has been developed from that used for the earlier processes

All mechanical impurities, etc., are removed from the viscose solution by filtering the same through cotton wadding and cheese cloth. The clear solution then passes to a small platinum cap in which are drilled 15 or 18 holes approximately 4/1000 inch in diameter. The cap is immersed in an acid bath and the alkali in the viscose as it emerges from the spinneret is neutralised by the acid, the particles of cellulose coming together into 15 or 18 filaments according to the number of holes in the cap. Instead of being wound upon a reel at this point these delicate threads are dropped over a bobbin or pulley wheel into a small hole in the top of a rapidly revolving spinning box This box turns at some 1,500 revolutions per minute, and the centrifugal force throws the filaments away from the center and winds them up in a cake, also putting a slight twist into the resultant yarn. The yarn is then reeled into bundles or skeins on a regular silk winder, being drawn from the inside of the cake.

The advantage of this method of spinning the soluble cellulose, as compared with former methods in which the filaments were reeled into skeins as soon as spun, is the delicacy of the apparatus. The filaments, until they have been stretched and dried, are exceedingly frail and the less they are handled, the more perfect the yarn produced.

All of the artificial silks take the same dyestuffs as cotton and are readily dyed, the luster being brilliantly accentrated especially by certain shades Care has to be taken, however, while the skeins are wet as the filaments loose much of their strength while in this condition The cellulose is very hygroscopic and after absorbing a large percentage of water, swells up and its physical structure is much weakened But as soon as the yarn dries again it is as strong as ever, and the luster returns with all of its original brilliancy The appended table, prepared by Haller, a French expert, shows some interesting figures obtained as the result of strength tests with various samples.

All the forms of soluble cellulose are progressive solutions, the chemical reaction being continuous, and great care has to be taken to spin the mixtures at exactly the right moment to get the best results In consequence, a fixed temperature is necessary for all rooms in which the solutions are mixed and aged

The artificial silk filaments when dry are of almost incredible fineness, one pound of yarn of some sizes containing as many as six hundred miles of individual filaments The bulk of the yarn spun contains about 33,000 yards to the pound, 18 filaments being twisted together to form the yarn A conservative estimate of the total length of the filaments produced daily at the present time by the world's factories is considerably over 3,000,000 miles every 24 hours

Cotton pulp is used instead of wood pulp in some of the foreign artificial silk factories and has been experimented with extensively in the United States, but wood pulp seems to be considered more suitable At the present time about 20 per cent of the world's consumption of silk yarn is the artificial product

Many millions in money have been expended in Europe and America in the perfection of the various processes for spinning artificial silk, and as is usual in the development of a new industry, the inventors and original pioneers as a rule have reaped but a small share of the profits The first American group to exploit viscose expended over $1,000,000 in experimenting, without obtaining any return whatever

		Absolute Strength in Kilogrammes per Millimeter of Diameter	
		Dry Thread	Wet Thread
Cotton, ordinary thread		11 5	18 6
Cocoon or Real Silk raw (in the gum)		50 4	40 9
" " "	boiled off (gum removed)	25.5	13 6
" " "	dyed black and weighted to 111 per cent	12 0	8 0
Artificial Silk	French Nitrocellulose Chardonnet	14 7	1 7
"	German - Nitrocellulose-Lehner	17 1	4 3
"	French - Cupra-ammonium-Pauly	19 1	3 2
"	English-Viscose-Steam	21 5	4 5

In another generation, however, the manufacture of artificial silk will probably be standardized, and as well understood as the wool and cotton industry of to-day

The World's Oldest Liqueur Distillery

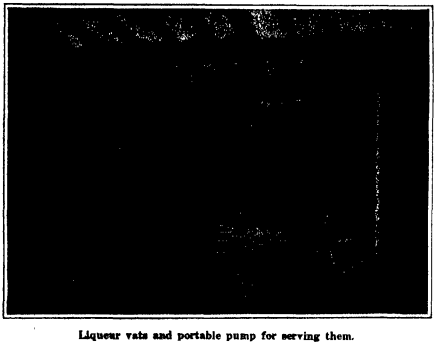
A Monastic Plant Dating Back to 1084 A.D.

THE world's oldest distillery well deserves its title, for it has been making the liqueur known as Chartreuse since the jolly Saint Bruno dedicated La Grande Chartreuse to the manufacture of this historic cordial in 1084. For hundreds of years, Chartreuse has issued from this monastic plant, designed as a monastery, and built like one, with its iron-barred windows

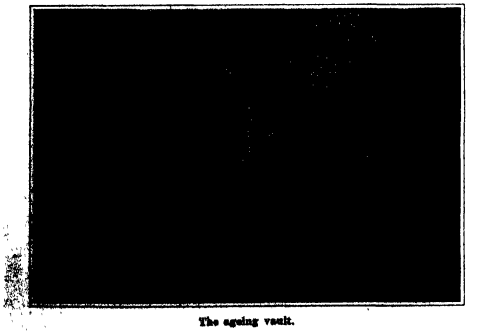
In the great building constructed for the monks not employed in the distillery, the cells were lighted only by iron-grated doors and the inmates here lived year after year without seeing the sun, receiving their food through the opening in the grated door and spending the hours in prayer, reading and work No one, outside of the monks working in the distillery, was allowed within its doors and the priestly workmen themselves did not know how the liqueur was made.

The first to discover the secret of making chartreuse from the rare herbs that are found in the Dauphine Alps which separate France from Switzerland was Bruno How he learned it is not known Some of the French mountaineers may have had crude liqueur stills, but history has no record of the fact Bruno kept the recipe to himself and mixed the aromatic herbs in the right proportions. In a vault where not even the monks could see him He alone knew the exact temperature to maintain in the steeping vats, and the different lengths of time needed to extract the essences from the various herbs The mixing of the liquids was also done exclusively by the saint None but he could gage the exact proportions to make the perfect blend When age caused Bruno to give up his duties, his successor was obliged to take an oath that he would tell no one of the secret processes, and that he would perform Bruno's work until compelled to give it up; when he would hand down the re-

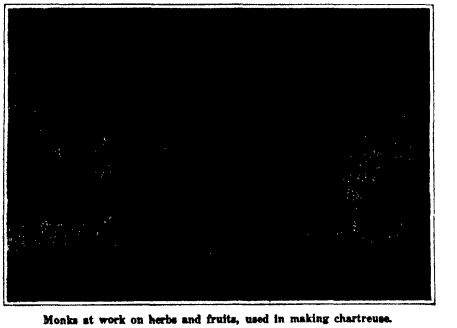
(Continued on page 585)



Liqueur vats and portable pump for serving them.



The ageing vault.



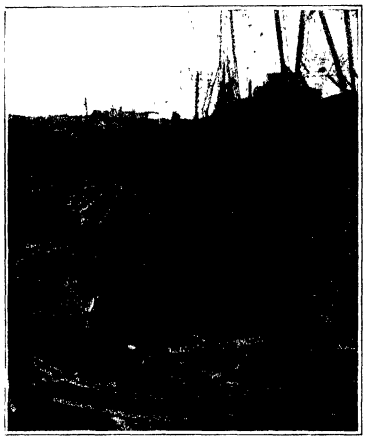
Monks at work on herbs and fruits, used in making chartreuse.

THE WORLD'S OLDEST DISTILLERY



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Panoramic view of the "Maine" and the inclosing cofferdam. To the extreme left is the bow, broken off and thrown astern. The boiler marks the region of the explosion. To the right of this is the after portion of the ship, which is practically intact



The bow, torn entirely away from the hull, was thrown around to starboard. The stem lies at right angles to the keel and in a horizontal position

Destruction of the "Maine" by a Low-explosive Mine and Her Own Magazines

THE Engineer Corps of the United States Army is to be congratulated upon having brought to a successful conclusion a difficult and unique work of marine cofferdam construction and excavation which in this particular class of work, is without parallel in the history of engineering. We refer to the successful unwatering of the sunken battleship "Maine." Sunken vessels have been recovered in various ways, but never, so far as we know, has a ship lying on the bottom been salved from the water by the method adopted in the case in question. The recovery of a ship of six or seven thousand tons displacement, lying in 47 feet of water upon a bed of mud and soft clay of approximately equal depth, is a problem of considerable magnitude, even when the hull of the ship is in an approximately sound condition; but when, as in the case of the "Maine," the forward third of the vessel has been blown entirely to pieces, the difficulty is many times multiplied. When the army engineers received instructions to recover the 'Maine' so that every part of the ship could be subjected to a thorough examination, they were confronted with a problem which they might well have pronounced impossible of solution.

The plan adopted of building entirely around the wreck a massive cofferdam wall extending from solid bottom to several feet above high water mark, was the subject of much criticism from the day the plans were first made public. Complete failure of the cofferdam was freely predicted by the engineering profession. Yet in spite of the difficulties due to the tendency of the mud-filled wall to leak and to yield by distortion, the fact remains that it has done its work, and that the army engineers have so far laid bare the wreck that not only will the after two-thirds of the ship be floated and towed away to be sunk at sea, but practically every part of the wrecked portion of the structure has been made to yield its quota of evidence in determining the first cause of the disaster.

The joint army and navy board appointed by the Secretary of the Navy has presented its report, and an advance official statement has been given out at Washington which says, "The board finds that the injuries to the bottom of the "Maine" were caused by the explosion of a charge of a low form of explosive exterior to the ship between frames Nos. 28 and 30, strake B, port side. This resulted in igniting and exploding the contents of the 6-inch reserve magazine, A-14 M, said contents including a large quantity of black powder. The more or less complete explosion of the contents of the remaining forward magazine followed. The magazine explosions resulted in the destruction of the vessel."

The investigation disclosed the fact that there is a fracture some 20 feet wide extending across the bottom of the vessel at a point about 100 feet from the bow. From the fact that the frames were still in position, though, of course, much distorted, the board concluded that a low form of explosive was used in destroying the vessel. A high explosive would have caused a much more complete destruction of the material in its immediate vicinity. Incidentally, the report sustains the findings of the Sampson board, which investigated the disaster in 1898, immediately after the "Maine" was blown up. That board located the point of the exterior explosion at about frame 18 on the port side, but its report was based upon an examination by divers working in 37 feet of water. The unwatering of the "Maine" has made possible a closer approximation to the truth and it is now disclosed that the point at which the vessel was ruptured lies between frames 28 and 31.

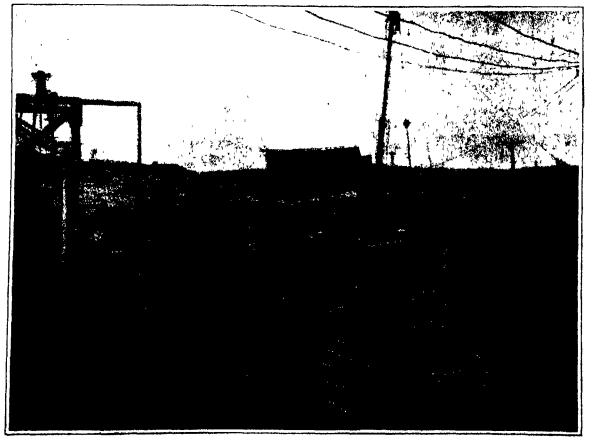
The after portion of the hull remains practically in place. Forward of frame 30 is a gap of about 20 feet, where the ship was cut in two, and forward of the confused wreckage lies the bow, which was blown entirely out of position, swung around to starboard, and broken off from the ship's structure at frame 14. The stem of the vessel, instead of being in the vertical position, now lies horizontally and at right angles to the keel of the vessel, a considerable section of the plating on the port side being still attached to the stem. A long strip of the double bottom lies on the top of the after edge of the severed bow, and beneath this second portion rests a section of the keel some ten feet in length. One end of it lies in the mud, and the other end, twisted backward and upward, is now resting against the shell of the detached section of double bottom. In places the keel has been turned entirely upside down, so that some sections of the bottom plating are uppermost.

The sequence of events on the night of the disaster is now clear. A charge of low explosive, probably a large quantity, was set off below the bottom of the "Maine," forward of frame No. 30 on the port side, and a few feet from the keel. How this destructive agent was contained, at what depth it was located, and how it was set off, will probably never be known. Whether the mine was touching the ship or on the harbor bottom, the force of the explosion would seek the line of least resistance, which would lie vertically through the body of the ship. The rush of gases tore through the double bottom and the shock and heat of the explosion set off the black powder of which there was a considerable amount in the magazine just above the point of explosion, and this, in turn, ignited the forward magazines. The enormous energy thus liberated, having the water below and on the sides of the hull as an abutment, expended its energy in tearing asunder and folding back the overlying protective and other decks of the ship.

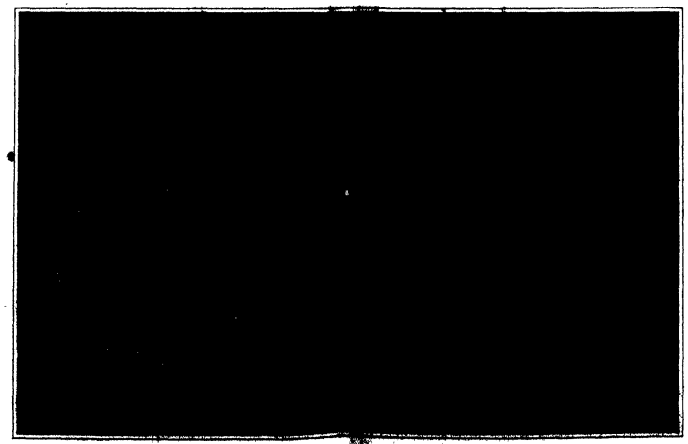
The illustrations which were published showing the recent wreck of the French battleship "Liberté" were strongly suggestive of similar illustrations of the wreck of the "Maine," published shortly after the event. The whole structure of the "Liberté" in the region of the explosion was opened out and folded back by the explosion of the magazines, presenting an appearance remarkably like that of the disaster in Havana Harbor. In the case of the "Maine" the magazines were set off by an exterior explosion, whereas on the "Liberté" the explosion was due to the deterioration and spontaneous ignition of the smokeless powder. It should be noted that outside of a comparatively small amount of ammunition for small arms, there was no smokeless powder on board the "Maine" at the time of the disaster.



View from amidships, looking toward bow, the wreckage of which is seen beyond the staging. To the right, in foreground, is one of the boilers; in the center is a portion of the keel.



Quarter deck and officers' quarters. Note the heavy timbers bracing the walls of cofferdam from the hull of the ship.



One of the 4-pounder tubes as recovered when the mud had been shoveled away. At this spot will be found the remains of Lieut. Merritt.



Looking aft into the body of the ship. In the foreground are the boilers. Aft is the timber bulkhead to be used in floating the hull.

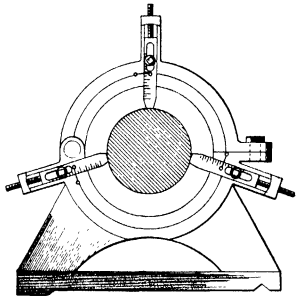
Suggestions for the Workshop

Ingenious Expedients of Resourceful Mechanics

A Steady Rest Kink

By H D. Chapman

IT is a bothersome task to change the steady rest jaws to accommodate different sizes of work. The following method was used to advantage. The steady rest was placed in position on the lathe and a line was scribed around the face of the rest as shown at *A*. The jaws of the steady rest were then



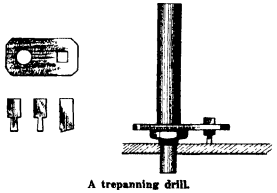
Steady rest with graduated jaws.

graduated in sixteenths of an inch on both sides of a zero line, as shown. The jaws were then placed in the steady rest and locked with the set screws after being set on the zero line. The jaws were then bored out while in position, thus making the graduation true.

Trepanning Drill

By Grover McKee

WHEN cutting out a hole in metal it is not necessary always to cut out all the metal in the form of chips and shavings. The most economical method is to cut out a piece of a desired diameter after the fashion of a surgeon when trepanning a skull. The accompanying illustration shows a method of doing this work. The drill consists of a shank provided with a reduced threaded portion and with a still further reduced projection, serving as a pivot. The plate



A trepanning drill.

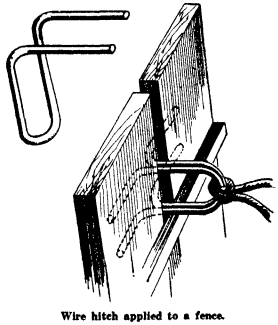
mounted on the shank is clamped in place by means of a nut which holds it securely against the shoulder of the shank. The plate is provided with a square aperture in which the tool is secured. The pivot of the drill is fitted into a small hole drilled in the center of the circle which is to be cut out. Then by driving the cutting tool into its socket and turning the shank, a circular slot will be made removing the metal in the form of a disk and leaving a hole of the desired diameter.

A Pocket Hitch

By Homer Cloukey

ILLUSTRATED in the accompanying drawing is a piece of stout wire about 8 inches long, shaped into a loop about an inch across with the free ends bent up at right angles to the plane of the loop. The drawing also shows the application of a pair of these bent wires to provide a hitch. They are slipped separately into a crack in a board fence and the tie rope or strap of a horse is attached. The girder of the fence will keep the strap from slipping to the ground and getting under the horse's feet.

This hitch may be applied to the side of a barn or any wooden wall if the owner carries a ¼-inch gimlet bit in his pocket with which to bore a couple of holes in the board. The chief advantage of this little appliance is that it can be carried in the coat pocket with convenience. It is also a feature that it can



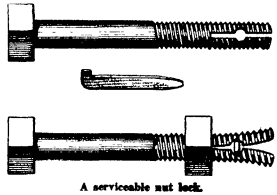
Wire hitch applied to a fence.

be made with the bare hands. The one drawback is that it will not hold a genuine "puller" which would pull the wires through the crack, but for ninety-nine per cent of driving and riding horses it is a reliable hitch.

Novel Lock Nut

By G. H. Ander

AMONG many devices for preventing nuts from working loose there is one in common use consisting of a cotter pin which passes through a hole drilled in the bolt. However, this is not perfectly secure. The writer has found the following method better. It consists in slotting the end of the bolt, lengthwise, with a hack saw, and after the nut is screwed into place, driving a small wedge into the hole to spring the ends of the bolt enough to prevent the nut from turning. The wedge itself may be held in place



A serviceable nut lock.

by bending the pointed end slightly. When it is desired to remove the nut the wedge may be driven out, whereupon the nut may be unscrewed very readily. Sometimes bolts are riveted or center-punched in order to keep the nuts in their place. This, however, makes it difficult to remove the nuts and it requires that they be re-tapped. Furthermore, the bolts themselves must be run through a die before they may be used again.

Two Novel Reamers

By H. D. Chapman

IN the accompanying illustrations two types of reamers are shown which should prove very useful in the workshop. The form shown in Fig. 1 is known as a floating reamer, the cutting portion being connected to the shank by means of a knuckle joint. The writer recently had a number of gear wheels to bore to a finished size of 1⅝ inches. The hole was roughed out with a 1 7/64-inch drill, after which the floating reamer was used to bring the hole to size. The reamer shank is tapered to fit the tail stock, while the shank and the reamer are coupled together by means of a tapered pin indicated at *A*. This reamer was in constant use for ten days and gave excellent service.

The expanding reamer shown in Fig. 2 is notable for its simplicity of construction. Unlike the majority of expanding reamers, this reamer permits one to ream down to the bottom of a blind hole, as there are no projections beyond the front face. It has been found that



Fig. 1.—A floating reamer.

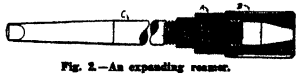


Fig. 2.—An expanding reamer.

with machine reamers there is an advantage in having a slight clearance behind the cutting edges, hence the reamer illustrated herewith is provided with such clearance. The shank of the reamer is indicated by the letter *C*. It is provided with a taper of 30 degrees at the end. Upon this shank is a lock nut *A* which may be turned by means of a spanner wrench. The cutter proper is indicated at *B*. This also is provided with flats for a spanner wrench, and there are six saw cuts in it, so that it can be expanded. In adjusting this reamer it will be found that the front cutting edge is expanded slightly more than that at the rear, so that it is possible to obtain a clean parallel hole.

Rotary Marking Gage

By William Grotzinger

THE ordinary marking gage fitted with a pin to mark a piece of work is open to the objection that the pin is liable to follow the grain, especially in hard wood, giving an untrue line. The marking gage may be improved by substituting a steel disk roller for the pin. A small projection of wood may be secured to

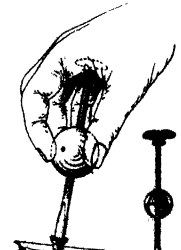


A rotary marking gage.

the body of the gage and upon this a steel disk about three-quarters of an inch in diameter may be fastened with a small screw, permitting the disk to rotate easily upon the body of the screw. In use the disk will mark a true line regardless of the grain of the wood.

Improvement for Screwdrivers

PICTURED in the accompanying drawing is a very simple device which will be found useful on small screwdrivers. It consists of a swivel head secured to the upper end of the screwdriver and serving as a rest for the palm of the hand. The shank of the screw-



Screwdriver with swiveled palm rest.

driver is fitted with a handle in the shape of a ball, secured by means of a transverse pin. This may be turned readily by means of thumb and finger while the palm of the hand is resting upon the swivel head and holding the screwdriver firmly in place.

The Inventor's Department

Simple Patent Law; Patent Office News; Inventions New and Interesting

Automatic Mixing Valve for Bathing Water

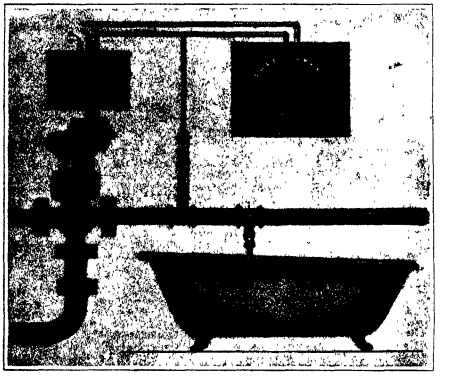
By Frank C. Perkins

THE accompanying illustration shows a unique German electrically-operated mixing valve by which any desired warm water temperature may be kept constant. It is adapted for use in large institutions, such as baths, sanitariums, and the like, as well as for various industrial purposes where constant temperatures are required. It will be observed that the temperature is controlled by a thermometer whose bulb reaches into the pipe containing the mixed hot and cold water. This thermometer is provided with platinum contact points connected to a double-switch lever, which may be set for the maximum and minimum temperature desired. This double switch may be seen directly over the bath tub in our illustration. Wires run from the switch to a set of relays, shown at the left-hand side, which control the circuit of a motor that operates the mixing valve. This valve connects either the hot water pipe or the cold water pipe or both with the mixed water supply pipes. The operation of the device is as follows: If it be desired to keep the temperature within the limits of 78 degrees and 82 degrees Fahrenheit, the two switch levers are adjusted accordingly. Thereafter, the apparatus operates automatically. If the temperature in the pipe with which the thermometer connects is below the minimum, the circuit of the motor will close automatically, opening the valve to the hot water supply until the temperature of the mixture has been raised to or above 78 degrees. If the mixture grows warmer than 82 degrees more cold water will automatically be supplied. A large number of bath tubs may be supplied through a single mixing valve and the temperature of the water supplied to each tub will automatically be maintained between the predetermined limits.

Removable Ambulance Linings

EVERY hospital for contagious diseases is now and then confronted with the serious problem of transporting persons without the loss of time necessary for proper disinfection of its ambulances. Many different patients, each suffering with a different disease, are received daily. Of course it is impossible to maintain a separate ambulance for each disease. A solution of the difficulty has been provided by the superintendent of a hospital in Buffalo. He has had five linings made which may be fitted into any of the hospital ambulances. One of these is used for scarlet fever cases only; another for diphtheria; another for measles; another for smallpox, and the fifth one for special suspected cases, or for other diseases not mentioned. These linings are stored in separate metal air-tight compartments built on a semi-circular platform at the edge of the garage turntable. The linings can either be disinfected in the ambulance, as all openings are made to shut tight, or they can be removed from the vehicle, placed on the ground and washed with soap and water. They may also be fumigated while in their storage compartments within the garage. Two men can exchange an infected lining for a clean one in five minutes. Thus a single ambulance is made the equivalent of five.

While this invention was originally designed for use by hospitals handling contagious diseases, it would no doubt be a benefit to the general hospital as well, because the latter is often called upon to transport patients supposed to be suffering with some simple malady, who, upon examination, prove victims of some dangerous and infectious disease. The advantage of using separate linings have been increased by the recent almost universal adoption of motor ambulances, which has rendered fumigation difficult, and washing almost impossible, because of wetting the electrical connections.



Automatic device for controlling the temperature of bathing water.

Particulars of the New Zealand Government's Offer of a Bonus of £12,000 (Nearly $60,000) in Connection With New Zealand Hemp

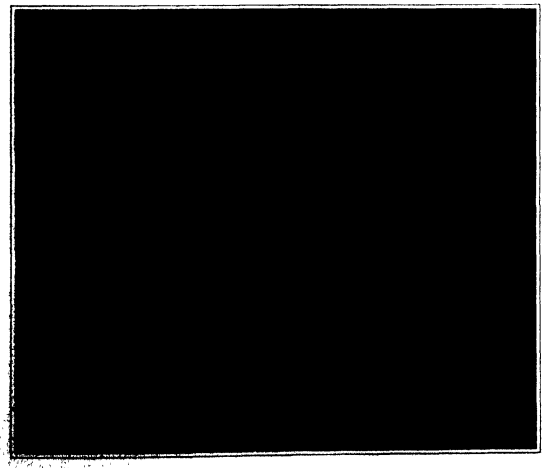
THE New Zealand Government has agreed to pay £12,000 (about $60,000) as a bonus or bonuses for improvements in connection with—

1. The extraction and dressing of fiber from the New Zealand hemp-plant (*Phormium tenax*), or
2. The utilization of the by-products obtained during the processes of extracting the fiber,

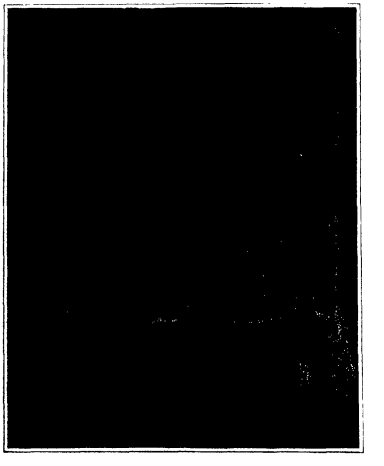
on condition that the machine or process in regard to which the whole or any part of the bonus is to be paid shall be recommended by the New Zealand Flaxmillers' Association, and approved by the Government.

The £12,000 will be paid, wholly or in part, for any of the following, viz:

1. A process of extracting and dressing the fiber of New Zealand hemp (*Phormium tenax*), whether by machinery or otherwise, whereby there shall be obtainable (*a*) a greatly improved quality of fiber marketable at a higher price, or (*b*) a substantial reduction in the cost of producing the fiber.
2. Any such process that shall produce a fiber fit for use in manufactures other than rope and twine spinning.
3. Any such process that shall render unnecessary any of the present operations involved in extracting and dressing the fiber, such as stripping, paddocking, or scutching.
4. Any improved method of separating the green envelope or the flinty or colored matter from the green leaf of the phormium plant so as to produce a strong white fiber the whole of which can be saved with little or no tow or waste.
5. Any means whereby the by-products obtained during the processes of extracting and dressing New Zealand hemp-fiber—such as the gum, dye, stripper-slips, tow-dust, or



The lining partly withdrawn.



End view showing the interior.

MOTOR AMBULANCE PROVIDED WITH REMOVABLE LININGS FOR CONTAGIOUS DISEASES

waste vegetable matter—shall be converted into a marketable commodity

Applications for the bonus must be addressed to the President of the New Zealand Flaxmillers' Association, Palmerston North, New Zealand, and must reach him not later than noon of November 30th, 1913 They must be inclosed in an envelope clearly marked "Application for bonus"

Each applicant shall state what lump sum (including the bonus of £12,000 or any part thereof) would be required to purchase the New Zealand rights of his machine or process in the event of such rights being acquired by the New Zealand Government for free use by the hemp-millers of the Dominion, or, if any applicant is unwilling to sell his rights, he shall state what *amount of bonus (not* exceeding £12,000) and what royalty he would require for the use of his machine or process

As soon as possible after the expiration of the time for receiving applications for the bonus (November 30th, 1913) the Flaxmillers' Association shall appoint a committee of not less than six of its members to open and examine the applications, to test such of the competing machines or processes as it considers worthy of trial, and to make recommendations to the Government as to the payment of the bonus

Each applicant must give, at his own expense, such reasonable demonstrations of the working of his machine or process as shall be demanded by the said committee, and such demonstrations shall take place in some convenient locality in New Zealand selected by the committee

The Committee shall notify the Secretary of the Department of Agriculture, Commerce, and Tourists at least fourteen days beforehand of the time and place appointed for such demonstrations, and shall allow any accredited representative of the Department to fully examine the working of the machines or processes that are being demonstrated

It should be noted that nothing in these conditions prevents a machine or process placed on the market prior to November 30th, 1913, from competing for the bonus

On completion of all the demonstrations it deems necessary, the committee shall consider the whole of the machines or processes submitted for competition for the bonus, and in doing so shall take the following matters in connection with each one into consideration

1 The amount of the lump sum or royalty required for the rights
2 The cost of purchasing, installing, and operating
3 The labor and time occupied in operating
4 The labor and time required after the operation and before the product is ready for packing
5 The cost of producing the fiber, tow, or other product
6 In the case of machines or processes for extracting and dressing the fiber, the percentage of fiber, and tow if any produced from a given weight of green leaves
7 In the case of machines, the simplicity, durability, and safety of the working parts

After considering the whole of the applications in the above respects, the committee shall forthwith submit to the Honorable Minister of Agriculture a report showing—

1 A complete list of all the applications received, giving the name and address of the applicant, the nature and purpose of the machine or process; the nature and value of the product, the quantity produced, the lump sum or royalty required for the rights, the estimated cost of purchasing, installing, and operating, the estimated labor and time occupied in operating, the estimated labor and time required after the operation and before the product is ready for packing, the estimated cost of producing the fiber, tow, or other product, the percentage of fiber, and tow, if any, from a given weight of green leaves, and, lastly, the simplicity, durability, and safety of the working parts
2. Whether they consider any machine or process worthy of the whole bonus, and, if so, which one.
3 If they do not consider any machine or process worthy of the whole bonus, then whether they consider any machines or processes entitled to a part thereof, and, if so, which ones and how much

For the information of persons who are interested in the above announcement, but who have little or no knowledge in regard to New Zealand hemp (or, as it is often called, New Zealand flax), it may be pointed out that *Phormium tenax* is entirely different from any other hemp or flax-plant The leaves from which the fiber has to be extracted are sword-shaped, and about four to nine feet long, they are moderately pliable, and of great tensile strength The fiber is embedded in tough vegetable matter containing a gum and a staining substance, and the greatest difficulty in the process of extraction is the removal of the vegetable refuse, gum, and dye without damaging or staining the fiber

Specimens of New Zealand hemp (*Phormium tenax*) can be seen in many botanical gardens all over the world

It would be of little use to send samples of the leaves outside New Zealand, as when cut they soon wither and become stiff and brown, and altogether useless for treatment by any known process.

THOMAS MACKENZIE,
Minister of Agriculture
Department of Agriculture, Commerce, and Tourists,
Wellington, New Zealand, September 22nd, 1911

Notes for Inventors

A Change Making Machine.—This machine has holders for stacks of coins, and an electric motor which reciprocates a carriage to which fingers are pivoted for ejecting the lower coins from the stacks, pivoted plates lying normally in the paths of the fingers to prevent them from engaging their respective coins, electromagnetic mechanism being provided to shift any particular one of the pivoted plates out of the path of its corresponding finger to permit the last to eject a coin The patent, No 1,007,167, is to Everett A Wickline of Olympia, Wash

Baked Beans as a Hair Tonic.—We have always understood that, as a diet, pork and beans was "filling" but it remained for a California inventor, Thomas H Bartlett, to find out a few years ago, that it had the property of "filling" the hair into the head and to cause that already in place to "stick to" its support In his patent, No 920,002, Mr Bartlett describes his hair tonic as consisting of pork fat, bean oil and other specified ingredients, and describes with great particularity the cooking of a very nice edible dish of baked beans preparatory to completing the tonic Thus in the description forming part of his patent he says "I take three cups of common white beans and three pounds of salt pork The beans are par-boiled, and then boiled with the pork for eight hours, and then covered tight and baked for twelve hours" With brown bread that would make a pretty good Saturday night tea in Boston

An Umbrella Useful with Big Hats.—An umbrella that should be popular with the ladies wearing large hats is shown in a patent, No 1,008,456, to Leo C Barr, of York, Pa The stick or staff is in sections which include parallel links so arranged that while the handle portion of the staff may extend up in front of a big hat, the links will extend back over the hat so that the center of the canopy of the umbrella or parasol will be about over the center of the hat, although the parallel links may be adjusted into alinement with the rest of the staff.

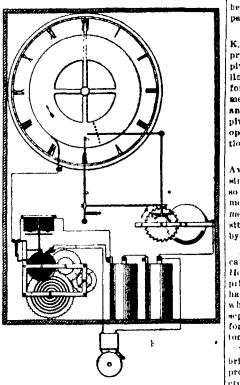
RECENTLY PATENTED INVENTIONS.

These columns are open to all patentees. The notices are inserted by special arrangement with the inventors Terms on application to the Advertising Department of the SCIENTIFIC AMERICAN

Electrical Devices.

SELF-SWITCHING ALARM.—B UHLMANN, 72 Plainderville Avenue, Garfield, N J This invention relates to burglar alarms for doors and the like, and its object is to provide a new and improved self-switching alarm, arranged to sound an alarm on retracting the key-controlled locking bolt of the door lock, and adopted to be normally held in a set position to permit of opening and closing the door, say during the day, without ringing the alarm

ELECTRICAL PROGRAM CLOCK.—GERTRUDE P. MILES, Sweet Home, Ore This invention relates to time-controlled electric alarms for periodically sounding alarms and its object is to provide a new program clock for use in schools, railroad stations, hotels and other places, and arranged to periodically sound alarms, to economize in battery power and to provide a mechanism of comparatively few

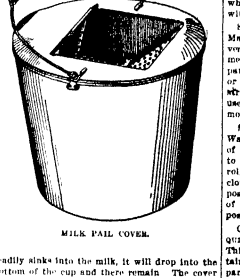


ELECTRICAL PROGRAM CLOCK

parts not liable easily to get out of order and not requiring delicate adjustment of the parts Use is made of an actuating and contact making member turning in unison with the minute hand of the clock and controlling periodically another contact making member for closing a circuit to sound an alarm The illustration is a face view of the clock

Of Interest to Farmers.

MILK PAIL COVER.—W R BUTNER, Topaz, Cal As soon as milk reaches the lowermost row of holes after a little has accumulated in the cup it is drained off from its upper surface and trickles through into the pail body, gradually filling the latter Any dirt in the cup cannot get into the pail being retained in the cup, as it cannot pass readily through the holes If the dirt happens to be of the kind which



MILK PAIL COVER.

readily sinks into the milk, it will drop into the bottom of the cup and there remain The cover can be disengaged and lifted gradually to different angles thus draining the milk out of the cup and leaving the dirt therein This requires but little practice The invention is shown herewith as applied to the pail The cover may be made of metal and of proper proportions to fit the standard pail

STEERING DEVICE FOR TRACTION ENGINES.—W D MILLER, care of Saco Mercantile Co., Saco, Mont In the present invention the improvement relates to traction engines and similar machines used for drawing gang plows over a field, and the object is to provide a new steering device for such machines, whereby the machine is automatically guided across the field in a straight line.

Hardware and Tools.

WRENCH.—C. G YOUNGQUIST and C. A YOUNGQUIST, 205½ Washington Street, Portland, Ore. This improvement pertains to wrenches, and it has for its object to provide one having an eccentric journaled to a movable jaw, with a worm mounted to rotate on the eccentric, so that by rotating the eccentric the worm may be moved into or out of engagement with the rack teeth on the shank of the teeth

SELF HEATING SOLDERING IRON.—A J WHITBECK, New Britain, Conn The object of this inventor is to provide a soldering iron having an improved construction and arrangement of the burner and means whereby the preliminary heating of the same is accomplished A number of heads of different sizes and shapes are provided and they may be used interchangably so that the tool may be instantly adapted to the character of the particular work to be done.

PIPE WRENCH.—W L. BESSOLO, P. O Box K, Spring Valley, Ill This invention comprises among other parts a handle and a jaw pivotally connected therewith to permit a limited oscillating movement of either, the former having a shoulder to limit its movement in relation to the latter in one direction, and a forward projection protruding above a pivot of the jaw to limit its movement in the opposite direction It is simple in construction, economical in cost and efficient in use

DIE HOLDER.—J. W CLARK, 707 Ashland Avenue, Muncie, Ind This invention provides a simple but powerful device for clamping a die, so that it will be held positively against movement in any direction, and wherein the holding *means may be firmly* locked in clamping position, without possibility of accidental release by any means.

ASH SIFTING SHOVEL.—C. F. HOFFMAN, care of Tuttle, McArthur & Dunnebacke, 501 *Hallitzer* Building, Lansing, Mich Among the principal objects which the present invention has in view are to provide an apparatus wherein the ash and partly burned coal are separated in the shovel; and to provide means for lifting the shifting device above the bottom of the shovel during sifting.

WRENCH.—F C BOTWRIGHT, 1825 Bainbridge Street, Philadelphia, Pa This improvement pertains to wrenches, and has reference more particularly to a device of this kind, comprising a pair of relatively movable jaws, means for actuating the same, and means whereby the jaws are released from engagement with an object between them when the wrench is turned in one direction

PNEUMATIC HAMMER.—V E LANE, 150 South Portland Avenue, Brooklyn, N Y Mr Lane's invention relates to pneumatic hammers, and has for its object to provide a detachable nose piece carrying the rivet set, or equivalent tool, and so arranged that the nose piece, when screwed on the barrel, carries with it the rivet set, while the last is in turn detachable from the nose piece independently of whether the latter be mounted upon the barrel or not

WIRE STRETCHER AND SPLICER.—M. W CORNETT, Miami, Texas. This invention is for use on fence wire or for tying wire around bales and the like Use is made of a handled winding shaft, having an eye and an arm, in which the winding shaft is mounted to turn, the arm having at its free end a hook for engagement with a loop on one end of a wire when splicing two wires, or for engagement with a fence post when stretching a wire

SAFETY RAZOR.—A ZILBERSHER, 1186 Madison Avenue, New York, N Y. The invention refers to a new and useful improvement in the art of safety razors and more particularly the invention involves a retainer or cap plate used on safety razors, the construction of which especially adapts it for use with blades which have been worn down more or less after honing or stropping

SHADE ROLLER.—C. K SNAVELY, 178 Washington Street, Bloomfield, N. J The aim of this inventor is to provide a roller arranged to insure an easy and smooth running of the roller for winding up and unwinding the shade cloth, to securely lock the roller in stopping position and to permit convenient assembling of the parts and securely holding the same in position

CURTAIN STRETCHER.—J O HOLMQUIST, 8318 Greenwood Terrace, Chicago, Ill. This invention relates to stretchers for curtains and analogous articles, and refers more particularly to a device of this class which comprises a frame including jointed bars, a brace member movably connected with these bars, and means whereby the bars, when extended, are constrained to assume positions at right angles with respect to the brace member

RABBI FASTENER.—I. G. FRENCH, 94 Winter Street, Orange, Mass. The object here is to provide a fastener which can be manufactured inexpensively from any suitable material, such as cast metal, which can be

stipulated without difficulty, by means of which the window sashes can be securely locked against accident or unauthorized opening, and which automatically locks when the window is closed

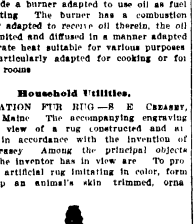
Heating and Lighting.

BURNER.—L M HASBROUCK, care of Continental Hotel, Broadway and 20th Street, New York, N. Y. An object of this invention is to provide a form of burner adapted more especially for use in an oil lamp, so constructed and arranged that cold air is supplied to not only the bottom part of the incandescent mantle, but is also supplied to the unburned carbonized gas at the upper portion of the mantle.

OIL BURNER.—W MC K. BURNS, 226 East 18th Street, Concordia, and R W BURNS, Cherryvale, Kan. The object in this case is to provide a burner adapted to use oil as fuel for heating. The burner has a combustion chamber adapted to receive oil therein, the oil being ignited and diffused in a manner adapted to generate heat suitable for various purposes. It is particularly adapted for cooking or for heating rooms

Household Utilities.

IMITATION FUR RUG.—S E CRESSEY, Alfred, Maine. The accompanying engraving gives a view of a rug constructed and arranged in accordance with the invention of Mr Cressey. Among the principal objects which the inventor has in view are: To provide an artificial rug imitating in color, form and nap an animal's skin trimmed, ornamented and arranged in simulation of rugs formed from natural skins, and to produce an article which is economical and durable. Where the rug is to be used as a floor piece and where further illusion is desired the head is mounted, a papier mâché or other suitable cranium being provided. This cranium is provided with teeth and eyes, as in rugs of ordinary constructions



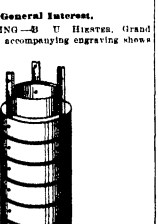
IMITATION FUR RUG

GAS LOG REST.—F S ALLEN, 517 West 134th Street, New York, N. Y. This improvement pertains to log rests used in fire places and the like, the more particular purpose being to provide a type of log rest suitable for use in connection with gaseous fuel and having a so-called "knock down" construction whereby the rest may be readily folded and unfolded for convenience in packing and shipping

SIPHON FLUSHING APPARATUS.—J I MEYER, 306 Lenox Avenue, New York, N. Y. The aim in this case is to provide a siphon flushing apparatus for flushing tanks, arranged to insure the emptying of the water of the tank from above the level of the water in the tank, and dispensing with submerged valves thus completely avoiding all leakage and waste

Of General Interest.

WELL CASING.—B U HIESTER, Grand Ridge, Ill. The accompanying engraving shows a perspective view of a number of units secured together in one manner. The invention relates generally to well casings, and more particularly it is directed to an improved means for holding together the units described and claimed in Letters Patent No. 1,001,523, granted to Mr Hiester. The aim of this inventor is to provide a means for securing in operative position a number of well casing units set forth in the above application, the said securing means being preferably vertically extending rods which may occupy a variety of positions with respect to the units



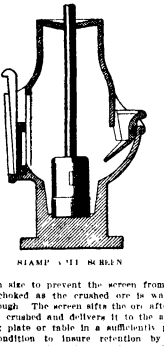
WELL CASING.

DISPLAY DEVICE.—W WELLER, Bonduel, Wis. This invention refers generally to devices which are adapted for use in displaying articles of furniture and more particularly it involves one especially intended to co-operate with the parts of a bed in order that the parts may be held in upright position and convenient for inspection

SHIP OR VESSEL.—G E ELIA, Hotel de Crillon, Place de la Concorde, Paris, France. This invention relates to ships or vessels and is particularly applicable for use in connection with vessels employed in naval warfare, the object being to preserve the stability of the same in the event of their being subjected to the effects of a submarine explosion.

METAL SPRING.—L. B DENIS, 185 Boulevard de Ménilmontant, Paris, France. In this invention the spring is formed from wire or metal rod of any convenient cross section bent on a flat or conical surface to form the outline of a conventional star, the radiating arms of which are subjected to torsional stresses when the exterior and interior supporting planes are moving together or apart

STAMP MILL SCREEN.—D C EN EAST ROLLINGVILLE, Calo. This invention consists of a screen to be used in the mortar of a stamp mill employed for the wet crushing of the ores of gold and other precious metals. The screen is shown in position in place on the mortar of the mill. The invention consists broadly in the number of bars arranged adjacent one another but spaced apart so as to provide openings therethrough, which openings gradually increase in size to prevent the screen from becoming choked as the crushed ore is washed therethrough. The screen sifts the ore after it has been crushed and delivers it to the amalgamating plate or table in a sufficiently powdered condition to insure retention by the quicksilver with which the plate is covered



STAMP MILL SCREEN

PROTRACTOR.—J GOODFELLOW, Cheever N H. This invention relates to a protractor of the type in which the various angles are designated on an arcuate periphery, whereby they may be transferred to any suitable work, and which is further provided with a supplementary arc or curve for determining various points and aiding in the solution of various geometrical problems

DAM.—J C WHERLON, Garland, Utah. The invention relates to hydraulic engineering, and its purpose is to provide a dam having a collapsible crest, which can be raised or lowered at will to permit flood waters to be safely discharged over the dam with the utmost safety to the dam and all the head works and controlling works connected with the waterway

GLUE MELTING PROCESS.—C M ZIMMERMAN, 221 West Third Street, Cincinnati, Ohio. In operation a converter is placed within the soaking tank and the glue put into the converter, and as much water afterward added as the glue can take up in passing into a jelly form. The vessel is then seated within the melting apparatus, where the glue is rapidly melted, and drips through the perforated bottom of the converter into the collector and thence runs out through the discharge pipes, thus soaking and melting are performed without transferring glue from one vessel to another

SAMPLE BOOK.—C. GREEN, 304 Canal Street, New York, N. Y. This invention relates to a sample book which is adapted to display textile fabric, wall paper or the like of various colors and qualities, both in their flat smooth condition and in a ruffled or rumpled condition, and in full yard length, so that *every* possible characteristic may be exhibited

FIRE EXTINGUISHER.—C H DRISCOLL, care of U. S. Smelting Co., Midvale, Utah. This extinguisher is arranged to utilize the tank containing the solution and the acid receptacle as a reel for the hose, the nozzle of which normally engages a lock for holding the reel against rotation, whereby the acid bottle is held suspended in the tank until the latter is unlocked or removal of the hose and the tank is rotated on unwinding the hose

DEPTH GAGE.—F J WALKER, Babylon, L. I., N. Y. In this gage the keepers are set back a substantial distance inward from the working edges of the head and the metal at these edges brought well to the blade so that the head gage will rest evenly substantially throughout on the surface, to which it is presented, and will not be raised therefrom when the head is laterally tilted

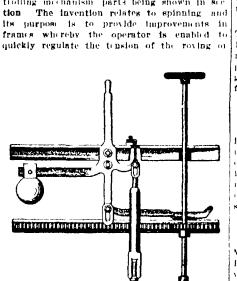
Machines and Mechanical Devices.

NEEDLE THREADER.—W J ROGERS, Box 567, 307 Madison Avenue, Plainfield, N. J. In this invention the improvement relates to needle threaders, and it has for its object to provide one having a handle with a guideway in which a member carrying a plunger is adapted to travel, a member carrying a thread catcher being pivoted to the handle, and having means for reciprocating the member carrying the plunger. Another object is to provide a spring arm adjustably mounted on the handle adapted to abut against the bottom of a needle bar for holding the plunger in alignment with the eye of a needle. The invention is shown in the engraving given the invention in position for service



NEEDLE THREADER

SLUBBING OR ROVING FRAME.—J D IRVING, 514 Edgmont Avenue, Chester, Pa. The engraving herewith shows a side elevation of a roving frame provided with auxiliary controlling mechanism parts being shown in section. The invention relates to spinning and its purpose is to provide improvements in frames whereby the operator is enabled to quickly regulate the tension of the roving on slubbing without knocking off and stopping the machine or without danger of injury to the hands. For this purpose use is made of an auxiliary tension regulating mechanism controlled by the operator and connected with the cross shaft, the mechanism extending to the front of the roller beam to be within convenient reach of the operator, to enable him to swing the shaft out or into gear



SLUBBING OR ROVING FRAME.

COPY HOLDER.—H URSCH, Little Falls, Minn. The object of the invention shown in the engraving is to provide a simple, economical and easily operated device which may be readily applied to and detached from a typewriter carriage, and which will travel with the carriage, will advance the copy synchronously with the advancement of the writing paper, and wherein the indicator of the type-writer carries the indicator of the copy holder, so that the two indicators always indicate on the copy that portion of the one that corresponds to the same portion of the other. The illustration represents the improvement in place on a typewriter



COPY HOLDER

Prime Movers and Their Accessories.

ROTARY ENGINE.—G T CUNNINGHAM, 1040 Margaret Street, Shreveport, La. The object of the improvement is to provide an engine wherein oppositely arranged blades are provided and wherein the motive fluid is permitted to act upon the blades during 180 degrees of their travel before exhausting, to gether with a simple and easily adjustable operating mechanism

CARBURETER.—M WERNOVA, care of Atlantic Yacht Club, Sea Gate, Coney Island, New York, N. Y. This invention has reference to certain improvements in carbureters for forming explosive mixtures and more particularly to that type of carbureter in which a liquid fuel is used and which is vaporized and mixed with air or other oxygen-bearing gas

CYLINDER AND WATER JACKET FOR INTERNAL COMBUSTION ENGINES.—J CRABB, West Union, Iowa. This invention provides a jacket constructed and arranged in such manner as to avoid breakage or other damage usually sustained by closed and rigid water jacket constructions caused by the expansion of the water contained therein when formed into ice, and provides a jacket to permit the rapid and easy separation of the same for repair or renewal

Railways and Their Accessories.

AUTOMATIC COUPLING.—H C NEWMAN, 1120 E Madison Street, Portland, Ore. This invention relates to couplers for train pipes of air brake systems, signal pipes, and steam pipes of railroad trains and refers more particularly to a device of this class comprising heads adapted to be arranged in juxtaposition to effect the operative connection of the pipes which are associated with the heads, one of the pipes associated with each head including a supporting means therefor, in combination with means controlled by the movement of the last-mentioned pipe, for operating the valves of the various pipes

MAIL CRANE.—F HANSEN, Woodbine, Iowa. This invention has reference to mail bag delivers and its object is the provision of a new and improved mail crane arranged to properly support the mail bag for normally engagement by the catcher with a view to unfailingly deliver the mail bag to the mail car

Pertaining to Recreation.

TOY GUN.—F A. KORP, Miami, Fla. This improvement relates to a gun which is made up of a frame member having a resilient band carried thereby, together with means for holding the band in stretched position and other means for releasing the band whereby the end of the band when released may be caused to strike some object, such as a fly or an insect

Pertaining to Vehicles.

COMBINED STEERING AND DRIVING MECHANISM.—S F SIGGERS and G A SIGGERS, Dolphus, Kan. This invention relates to motor vehicles and particularly to the means for driving and steering the front wheels of the vehicle. The object is to provide a motor vehicle with front steering wheels and with means for transmitting power to said wheels without interfering with their steering action. It provides a gearing for motor vehicle wheels, which will drive and shaft the same

RESILIENT METALLIC VEHICLE WHEEL.—W H WAITE, Jr., care of Atlantic Creosoting and Wood Preserving Co., Norfolk, Va. The purpose of this invention is to provide a vehicle wheel tire composed mainly of resilient metal, which is constructed having cooperative elements which are so combined that equal support and resilience under load strain are afforded for all parts of the wheel

WAGON.—T B MASON, 209 Warren Street, Trenton, N. J. This invention relates to wagons for carrying ashes, garbage or other refuse, and refers more particularly to a wagon comprising a body adapted to hold the material a movable material-receiving member having a normal position wherein it discharges into said body and forms a closure therefor, and means for operating the member.

Designs.

DESIGN FOR OPEN MESH FABRIC.—A. G JENNINGS, care of Jennings Lace Works, Park Avenue, Brooklyn, New York, N. Y. This ornamental design comprises open mesh work of pear-shaped design the rows of which alternate so that the points and heads of the pear shaped patterns are reversed. The design is original and the effect attractive. Mr Jennings has also designed an ornamental Face Veil with two border bands of slightly different widths, the bands slightly separated. The interior space comprises an ornamental field of lace-work of a beautiful pattern.

NOTE.—Copies of any of these patents will be furnished by the SCIENTIFIC AMERICAN for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

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SEALED PROPOSALS.

PROPOSALS FOR BRICK DORMITORY, CENTRAL STEAM HEATING AND POWER PLANT Department of the Interior, Office of Indian Affairs, Washington, D C November 19, 1901 Sealed proposals, plainly marked on the outside of the sealed envelope "Proposals for Brick Dormitory, Central Steam Heating and Power Plant, for the Rapid City Indian School South Dakota, and addressed to the Commissioner of Indian Affairs, Washington, D C will be received at the Indian Office until 2 o'clock, p m, December 9, 1901, for furnishing materials and labor for the erection of a brick dormitory, central steam heating and power plant at the Rapid City Indian school, South Dakota, in strict accordance with the plans, specifications and instructions to bidders which may be examined at this Office the offices of the Supervisor of Construction Denver Colorado, the American Contractor, Chicago, Ill Scientific American, New York City, the Improvement Bulletin, Minneapolis Minn, the Journal Rapid City, South Dakota, the Bee, Omaha, Nebr, the United States Indian Warehouses at Chicago, Ill, St Louis, Mo and Omaha Nebr, the Builders' and Traders' Exchange at St Paul, Minn, and at the school For further information apply to the superintendent of the Rapid City Indian School, Rapid City, South Dakota C F Hauke, Acting Commissioner

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Correspondence

[The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.]

The Technique of Clam Digging

IN our issue of December 16th, on page 564, we published a letter from Mr Hugh N. Johnson criticising our advertisement headed the "Technique of Clam Digging." The advertisement referred to appeared in the same issue on page 560 Our reply to Mr. Johnson's letter, which was inadvertently omitted last week, is as follows.

Your criticism of "The Technique of Clam Digging" is just—from the viewpoint of the Pacific Coast and some parts of the Atlantic Coast

The species of *Tapes* and *Saxidomus* which flourish on the Pacific coast, and the *Mya Arenaria*, which multiplies in long-armed softness on the north Atlantic coast, are harvested with a fork and bucket at low tide

Plainly the writer of the advertisement had in mind only the *Venus Mercenaria*, which, despite its suggestive name, is the aristocrat of the clam family, the only one having real gastronomic distinction It is true, the soft, long-fingered clam dug out of the mud appeals to many tastes when steamed and that it is also used sometimes for chowder, but it never ventures to raise its long, humble neck in the presence of its relative, the little neck

With the assumption of superiority familiar in the New Yorker—anybody who manages to exist in the metropolis for six months calls himself a New Yorker—the writer of the advertisement calmly took for granted that the only clam worth talking about is the lordly *Venus Mercenaria* In New York it is "the clam"—the long-necked variety being invariably designated as "the soft clam."

And the *Venus Mercenaria* or hard clam, or little neck, or quahog, is harvested exactly as described in the advertisement

The mistake the writer of the advertisement made was in assuming that this clam, more or less local to a small part of the seaboard, is the only clam He is a victim of insular prejudice rather than of ignorance —EDITOR

A Mechanical Evolution and Smokeless Cities

To the Editor of SCIENTIFIC AMERICAN.

No smoke on our rivers, no smoke on our lakes, no smoke from our factories, in fact smokeless cities, is the immediate boon in store for us through the most meritorious invention of the compressed-air internal-combustion engine* Before briefly explaining the principle of this beautifully simple motor, it may be well to give a short *résumé* of the development of the marine engine The oldest marine engine and boilers I ever had charge of were fitted in the steamer "Windermere" by John Penn & Sons of Greenwich in the year 1857 It was in this vessel that the first surface condenser, that most important of all adjuncts to the marine engine for salt-water service, was fitted by Samuel Hall The working pressure of steam was but 15 pounds per square inch, speed of piston slightly below 200 feet per minute, and the combined weight of engines, condenser, pumps, boilers and water therein equaled one gross ton for each indicated horse-power

Now the reduction of weight for power developed is the great desideratum for marine propulsion at least, and this is certainly true as regards propulsion in air The reduction of weight for a given power is most largely due to augmented piston speeds This speed has advanced during half a century from 200 feet to 1,000 feet a minute for reciprocating engines, and to 20,000 feet in rotary engines The other factors contributing to efficiency are higher steam pressures, greater vacuum, and stronger materials

Though the continuous development of the tri-compound and quadruple-expansion engines was inaugurated by the construction of the "Aberdeen," built in the year 1882 by R. Napier & Sons, the first triple-expansion engines were fitted in the "Propontis" by John Elder & Co., in 1874, their dimensions being 28 + 41 + 62 × 42 inches. The advancement of the triple or multiple expansion system solely through the failure of the Rowan boilers This, however, is no exception to the rule, the boilers have always been the troublesome and expensive element of marine propulsion, and their elimination will tend wonderfully to simplify the work and responsibility in the engine room

Fifty years ago the average consumption of fuel was about 5 pounds per indicated horse-power per hour. To-day this consumption is reduced to one-half pound of fuel per horse-power hour. The following table shows in chronological order over half a century.

The Reduction of Fuel Consumption per Horse-Power Hour.

	Fuel Consumption, Pounds
1850. Steam pressures 15 pounds	5
1860. Steam pressures 25 pounds with surface condensation	3
1870. Compound engines	2¼
1880. Triple-expansion	1⅝
1890 Quadruple-expansion (increased pressure)	1¼
1901 Internal-combustion engine	½

As it may appear somewhat remarkable, I may point out here that the consumption of crude oil fuel works out about the same, whether it be used explosively or to generate steam The space which could be saved for the accommodation of passengers and cargo in a 20-knot steamer by substituting the compressed-air, crude-oil, internal-combustion engines for the familiar steam engine or turbine installment, measures fully 5,000 cargo tons Now I venture to assert that the greatest mechanical invention since Samuel Hall invented the surface condenser, or probably since Watt devised the steam engine, is now afloat on our Great Lakes, and is being duplicated in that locality for coast service This is the Diesel improved internal-combustion motor or engine As this engine is beautifully simple and works with crude petroleum, of course without steam, it seems destined to quickly displace the steam turbine, and with it, the use of coal and steam, for propulsion at least, will no longer be required An engineer cannot witness the retirement of those good and faithful old servants without feelings of regret, especially since the advent, on a magnificent scale, of the steam turbine was so recent; still, it seems quite apparent that their day of usefulness is almost over. The adoption of the steam turbine was too long delayed to admit of a long lease of life, the principle of the De Laval impulse turbine having been clearly illustrated more than two thousand years ago. The internal-combustion engine of to-day does not weigh more than one-fifth of that of a marine engine and boilers of equal power, and when it is considered that there are gasoline engines on the market weighing not more than 2½ pounds a horse-power, who shall say that instead of being below one-fifth of the weight of the steam engine and boiler, the crude oil combustion motor may not be reduced to one-tenth or less of the weight of the steam boiler and engine instalment?

To me it appears that the sterling merit of this new invention is the beautifully simple means of firing the charge. Instead of the fickle and complicated electric spark system, the crude oil is ignited by a sudden and high degree of air compression within the cylinders. This device is not only reliable, but is very simple, which is of the utmost value for marine propulsion at least

Consider a steamer with large boilers, coal bunkers, coal chutes, coaling hatches, and all the paraphernalia for operating, cleaning, and repairing, and then try to imagine all of this weight and complication absolutely eliminated, and a space six times as large as the engine room thrown open for the stowage of cargo or the accommodation of passengers. Well, this is just what the adoption of the

*The invention of Dr. Diesel.

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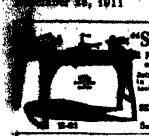
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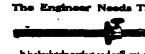
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crude-oil motor will accomplish. Bearing this in mind, and with many concrete examples of this great transformation in evidence all the world over, I may venture to predict that no marine boilers and steam engines, for the propulsion of ships, at least, will be seen anywhere under construction, after the Panama canal has experienced five years' service.

Chicago, Ill. JOSEPH R. OLDHAM.

A Fatal Omission

To the Editor of SCIENTIFIC AMERICAN:

I want to compliment you on your editorial under the heading of "A Fatal Omission." I have no interest whatever in the Pennsylvania Railroad, but I do feel a most serious blunder has been made by New York city in not arranging subway connection with their new station I would like to see the press unitedly agitate the matter so that the convenience might be speedily brought about, and the general public receive a benefit that they are entitled to When we consider that ten million passengers were carried through the station the first year of its existence, it is a disgrace to the city that an immediate effort for relief is not put under way.

W. F. HARTRANFT.

Jersey City Heights, N. J.

The Current Supplement

THE front page article of the current issue, No 1877, of our SUPPLEMENT, is devoted to an illustrated description of the 3,000-horse-power Hydros Electric Power Plant at Cannon Falls, Minnesota —Prof. Wedgworth's article on the Psychology of Light reaches its second installment.—Frémont's new test for steel rails, which promises to become a standard method, is described —An article by P. V. Vernon deals with the influence of composition and previous history of steel on the power required to cut it —An article on "Developing a Small Water Power Plant" should prove of special interest to farmers and others located at a distance from city centers.—G. C. Sawyers, cheese expert, writes on the "Manufacture of Cheddar Cheese."—At the opening of the winter season an article on "Skis, Their Construction and Use," will be welcomed by many of our readers —A very scholarly account of "Wheels, Ancient and Modern," from the times of primitive man to the day of the steel-spoke automobile, is given by H L Heathcote —Condiments and Stimulants have their use, as well as abuse They are discussed from a scientific standpoint in an article derived from *Prometheus*

World's Oldest Liqueur Distillery

(Concluded from page 575.)

cipe to his successor, who would also be oath bound.

And so operations continued in the first monastery for nearly six centuries, when the order built another plant near Fourvoirie, the supply of raw material at the original location being exhausted The new plant was strictly ecclesiastical in architecture and cost nearly 5,000,000 francs—all paid out of income from the sale of chartreuse to the monastic orders in France, for until fifty years ago it was not drank by anyone except the French monks. It was regarded as a sacred beverage, and to sell it outside of the church was sacrilege. The mystery of chartreuse making and its peculiar taste were two of the reasons for its popularity, which was so great, once it had come into public use, that it was soon shipped, in kegs, all over Europe, to be bottled and sold by the bottle or glass in the cafés. When the Fourvoirie plant was working to its full capacity the output was 15,000,000 gallons a year.

In making the cordial, the monks gathered the dozen different species of herbs which were required to give the right blend These were first thoroughly dried, in the storehouse, being spread out on the floor, and exposed to air currents. The different herbs were then placed in spring water in separate vats, which were heated by wood fires—this for extracting the juice. The tanks were covered and the steeping process occupied about twenty-four hours, when the juice was drained off through pipes in the lower parts of the cooling vats. Next the liquid was distilled, the process being quite similar to the distillation of whiskey.



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Schulz simply sent a few American ribbons and some of his own ribbons to the Koenigliches Material-Pruefungsamt – the Royal Laboratory for Testing Materials. In a few weeks he received a report in which he was told that the life of an American ribbon was twice as long as his own, that the fabric of the American ribbon was composed of this and that material and had a tensile strength three times as great as Schulz's, that the ink of the American ribbon was composed of such and such chemicals and pigments, with the result that its record was legible for a longer time and absolutely light-proof.

This is the kind of work that the Koenigliches Material-Pruefungsamt does for any German manufacturer. It gives expert information to him who is entitled to it, and at a price that doesn't begin to pay for the elaborate scientific investigation involved. Whether it be a girder for a bridge, or a button for milady's shoe, that public laboratory tests anything, and tells the German what he must do to make it better and cheaper, if possible.

In the next number of the Scientific American we will publish an article by Mr. Waldemar Kaempffert, Managing Editor of the Scientific American, on this remarkable institution.

We sent Mr. Kaempffert to Europe in order to study the part that science plays in German business and public affairs. His article on the Koenigliches Material-Pruefangsamt will be the first of a series in which new phases of German science and commerce and education will be revealed.

After you have read the series you will feel that "Made in Germany" means a good deal more than mere cheapness; that there may be far more science in the cheap German penknife bought on the street corner than you may suspect; that science, and not simply cheap labor, has made Germany a great commercial nation, and the German city the best-governed municipality in the world.

Watch the Scientific American advertising pages for announcements of the articles still to appear.

Then came the blending of the different extracts into the secret composition that has given chartreuse the flavor and the exhilarating effect which has made it famous This, the most delicate process, was supervised by the director; and before it was performed, mass was observed to sanctify the product

It is not generally known that three forms of the liqueur were manufactured at the chartreuse establishment, the green and the yellow chartreuse all know, but there is a much weaker extract, the white chartreuse, which was drunk with water by all the employees of the monastery, and was given to the stranger who accepted the hospitality of La Grande Chartreuse for a meal

Until seven years ago the Carthusians kept up their industry They also worked farms; built schools and churches for the peasants, and laid out some of the finest roadways in Europe In 1904 the French government seized their property, forced out the Carthusians and since then have been making the liqueur—but it is merely a poor imitation of the brew prepared by the monks

NEW BOOKS, ETC.

THE COPPER HANDBOOK 1910-1911 Vol. X Compiled and published by Horace J Stevens Houghton, Michigan 8vo; 1902 pp

In "The Copper Handbook" we find a vast amount of information, both historical and timely Copper in its geological, chemical, and mineralogical aspects, its mining, milling, and concentrating, its hydrometallurgy, pyrometallurgy, and electrometallurgy, its alloys; the various grades, uses, and substitutes, a glossary of mining terms, chapters on the copper deposits of the Americas, of Europe, Africa, Asia, and Australia, a section of reliable and valuable statistics—in a word, we have a handbook crammed with facts pertaining to copper in its relation to industry, and to the industries Three-fourths of the space is taken up by an alphabetical presentment of the copper mines of the world, their location, date of organization, capitalization a description of shafts and levels, the nature and extent of deposits and present condition of activity—many being characterized as "idle" for years "idle and apparently moribund," and "dead" There must be upward of 9,000 mines described in this section of the work

THE ART OF LIFE The Way to Health and Longivity By Jogender Lal Chundra, L. M. S. Calcutta, India. Published by the Author, 5, Gopee Krishto Paul's Lane, 1911

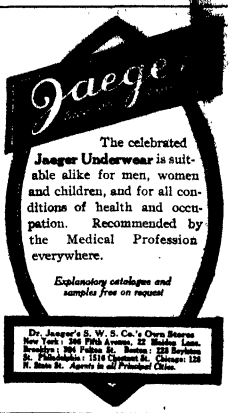
The spelling of the subtitle is the author's In spite of the quaint English and fantastic spelling, Dr Chundra's curious little work is on the whole sane and progressive Drugs and drug treatments, while not entirely condemned, are subordinated to hygienic and dietetic principles The papers embody, among other themes a distinct contribution as to the value of common salt in the system, a survey of the diseases most prevalent in India, with notes on their geographical distribution and the conditions which favor them, and an incursion into so called "personal magnetism," colored, of course, by the Oriental viewpoint and philosophy

KING ARTHUR AND HIS KNIGHTS An Abridgment of Le Morte d'Arthur Edited by Henry Burrowes Lathrop. Illustrated by Reginald Birch New York The Baker & Taylor Company, 8vo Price, $1 50 net

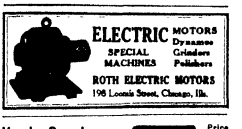
Emphasis is laid upon the fact that this is not a series of excerpts from the original, but a careful abridgment in which the utmost has been done to retain in one volume of moderate size all the vivid coloring and incident of Malory's narrative The story of the Morte d'Arthur is told, substantially as Malory told it, in a connected series of vital episodes that can not fail to appeal strongly to young people Indeed, the sole purpose is to bring within the scope of youthful interest what is truthfully claimed to be the most delightful record of its kind which the English language has to offer

ANIMAL INTELLIGENCE Experimental Studies By Edward L Thorndike New York The Macmillan Company, 1911. 8vo, 297 pp; diagrams.

The author here presents in one volume a number of monographs which have been published separately and as papers in scientific periodicals His avowed purpose is to make accessible to students of biology and psychology his own experiments in animal intellect and behavior His research has led him to deprecate the employment of introspection as the chief method of psychology, which he prefers to regard as largely the science of behavior and a virtual extension of physiology. The experiments are primary and simple, but, like all simple things of this kind, illuminate the higher phases of being for those who are able to read their symbolism aright.

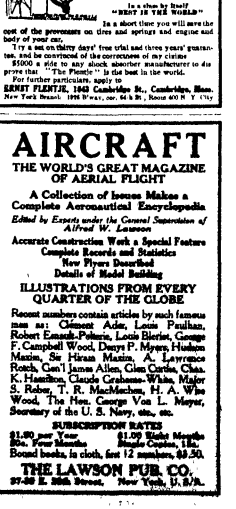












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Notes and Queries.

Kindly keep your queries on separate sheets of paper when corresponding about such matters as patents, subscriptions, books, etc. This will greatly facilitate answering your questions, as in many cases they have to be referred to experts. The full name and address should be given on every sheet. No attention will be paid to unsigned queries. Full hints to correspondents are printed from time to time and will be mailed on request.

(12582) E McGee asks Would you be so kind as to give me an explanation of a statement made by Carhart and Chute in regard to the transformation of energy. They say: "The energy of the solar system is becoming all the time less and less available." A You omit one very important word in making your quotation from Carhart and Chute's Physics page 77. That word is "*therefore*." The sentence as given in the book is as follows: "The energy of the solar system is therefore all the time becoming less and less available." *Therefore* refers back to what has preceded. The radiated energy of the sun and other kinetic energy which is employed in doing work in nature or for man's needs, is *useful* energy. And also is useless and becomes waste heat. So the authors say therefore the amount of energy which is available for useful purposes is all the time becoming less and less. It seems to be a plain statement. The sun is radiating heat all the time into space, and this heat does not, so far as we can determine do any useful work. It reduces the available energy of the sun and is lost to us. There is less that we can have, less that is available.

(12583) R J M. asks Why does silver or silverware, when placed in an aluminum vessel with boiling water come out with a brilliant appearance as if new? Please give me the reason. A The cleansing of silver as you describe is an electrical process. A feeble electric current is produced between the silver and the metal pan and a new and fresh surface of the silver is exposed.

(12584) H E asks An argument arose regarding the following questions and I would be pleased if you would give me some information regarding same. What is the horse power of an engine 10 × 10 at 100 pounds pressure? If a suitable size low pressure be added to a 10 × 10 engine at 100 pounds pressure, what horse power would it develop? A Your question involves a large part of the theory of steam engineering. The horse power of the engine depends upon the speed of the engine (which you do not give) as well as upon the cut-off and consequent expansion and mean effective pressure, which latter is at ways less than the initial or boiler pressure. If a 10 × 10 engine is operated at one quarter cut-off and 100 pounds steam pressure by gage, the mean effective pressure (disregarding all losses) is 48½ pounds above vacuum and the pressure at the end of the stroke will be 25 pounds above vacuum. If the steam is exhausted at the above 25 pounds pressure the horse power of the engine will be about 17½. If however, this steam is now turned into a low pressure cylinder 20 inches diameter and 10 inch stroke, an approximate horse power of 17½ can be developed by expanding the steam to a low terminal pressure and exhausting into a condenser. The engine has now become a compound. But the same power could be developed (theoretically) by operating the low pressure cylinder alone at 1/10 cut-off and omitting the high pressure cylinder. The only advantage in using the two cylinders that is a compound engine is the higher theoretical economy due to expanding the hottest steam in a cylinder which is hotter, on the average, than the temperature of the second cylinder in which cooler steam is worked. If an engine could be made with a single cylinder of some imaginary material without any conductivity or capacity for heating it would do all that a compound engine could do. If a glass cylinder were possible to operate, there would be no advantage in point of economy in compound engines, as a single large cylinder of glass would do all the work of a series of two, three, or more of the heat-absorbing metal like iron, brass, and the like.

(12585) A B F says. I would be pleased to know if the combination of gasoline and coal oil (as used in lamps) in a gasoline engine, will produce more power than gasoline alone. Please give B T U, of gasoline, also of naphtha and coal oil. A Gasoline and kerosene have different specific gravities, and if mixed for use in an engine, gasoline will evaporate first and leave the heavier part of the coal oil for the last. The kerosene has a greater fuel value than gasoline per gallon, though very closely the same per pound. Kerosene is a cheaper fuel than gasoline, both because of its slightly greater heat value and because of its much lower cost per gallon. The fuel values of the various petroleum products, such as gasoline, benzine, kerosene, etc., are over 20,000 B T U per pound, and differ little, one from the other.

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Two Half-Told Tales: **An Old Game In the Odor of Sanctity,** by Henry van Dyke.

Abbey's Last Mural Paintings, by Royal Cortissoz. Illustrated with the artist's additional mural decorations for the Capitol at Harrisburg, and with studies of individual figures.

The Sheep of the Desert, by Kermit Roosevelt. An account of a hunting trip in the Mexican Desert. Illustrated with the author's photographs.

YOU WILL WANT TO READ IN 1912:

"The Turnstile," A. E. W Mason's serial.
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President Finley's "Traces and Influence of France in the Settlement of America." The romantic story of the changes that have followed the old French explorers -- La Salle, Marquette, Joliet, and others
Price Collier's "Germany and the Germans"
"The Witching Hill Stories," by E. W Hornung, creator of Raffles

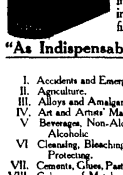
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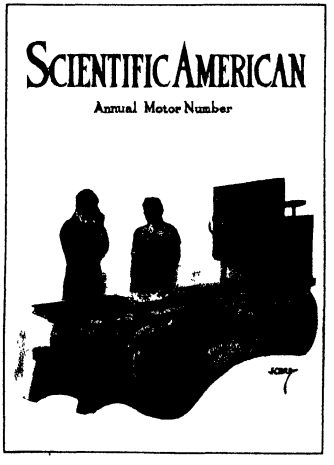
ANNUAL MOTOR NUMBER

MOTOR CARS MOTOR TRUCKS MOTOR BOATS MOTOR CYCLES

JANUARY MAGAZINE NUMBER OF THE SCIENTIFIC AMERICAN

ISSUE OF JANUARY 6, 1912

Although we are well past the dawn of the "hydrocarbon age," we have not yet reached the meridian period. Each year there are new developments making for the betterment of motor-driven land and water vehicles. The improvements that are to be brought out in 1912 are exceptionally interesting and will be outlined in detail in this number. The following articles will appear:



Selection of a Motor Truck

In what respect do leading types of motor trucks for 1912 differ mechanically? How can the owner best protect his investment? What are the costs of upkeep and operation as compared with those of horse-drawn trucks? Can truck chauffeurs be made of ordinary teamsters? These are vital questions to the intending purchaser of motor trucks, which will be ably discussed.

Will Rubber Tires be Supplanted?

While tire manufacturers are doing everything that is humanly possible with rubber and fabric, yet, undoubtedly, there is no feature of a motor car that gives the owner more concern than the tires. The ability of rubber to stand up under the terrific shocks and wearing grind of service is a marvel. Hundreds of inventors have been busy at the task for years, no substitute for the rubber tire has yet been developed to such a degree as to supplant the standard pneumatic tire. Just what has been done in the past, and what promises are held for the future, will be brought out in this article.

The New God of War—Gasoline

In this article the prominent place occupied by the automobile in European military maneuvers is described. In the United States the armored automobile has been entirely neglected. In Germany in time of war every car in the country, private as well as public, is placed at the beck and call of the Government.

Auxiliary Uses for Motor Vehicle Engines

Herein are described a number of novel uses for the engine of a motor truck or an automobile.

The Comparative Cost of Light and Heavy Cars

This question is debated by a man who has made painstaking and impartial comparison of every detail of his personal expenses in connection with two cars, one a typical light car, and the other a standard heavy car.

Making the Starting Crank Obsolete

One of the most noticeable features of the 1912 car will be the absence of a starting crank in front of the radiator. The desirability of providing a means for starting the car from the driver's seat was expressed years ago, and its necessity has been urged more clamorously each year. Now, suddenly, a score of different self-starters have been developed, and the majority of manufacturers are going to bring out their 1912 cars with some sort of a self-starting mechanism. The leading types of self-starters will be explained so that any automobile owner can understand them.

Driving the Car at Night

To obtain the full value of a motor car, it must be available for service at night as well as during the day time. There is much more to safe night-riding than a pair of powerful headlights. There are new developments which every automobilist should know.

The Easy Riding Car

The pleasure vehicle has now become so standardized that the riding qualities of an automobile receive much more attention than heretofore. As a consequence, designers have been devoting much thought to the springs, shock absorbers, upholstering, the balance and hang of the body, and all the features that enter into the making of a comfortable car. The prospective purchaser should know that the distribution of weight on a car is an important factor in making it "stick to the road." A badly-bal d car will possess poor traction qualities owing to the tendency of the rear wheels to bounce off the road's surface.

A Fertile Field for Inventors

Under this subject are detailed many ingenious devices that inventors have developed of late for use on automobiles.

Lessons in Everyday Motor Boat Designs

The racing motor boat is very properly considered a useless craft for pleasure purposes. In the present article, however, it is clearly brought out that the design of the pleasure boat has been materially improved by the development of the racer.

Motor-Cycle Developments

What is being done to improve that noisy, sputtering, two-wheeled vehicle? Among the prominent features for 1912 are footstarters, multiple jet carburetors for slower running in cities, improved mufflers, and floating seats to make riding more comfortable.

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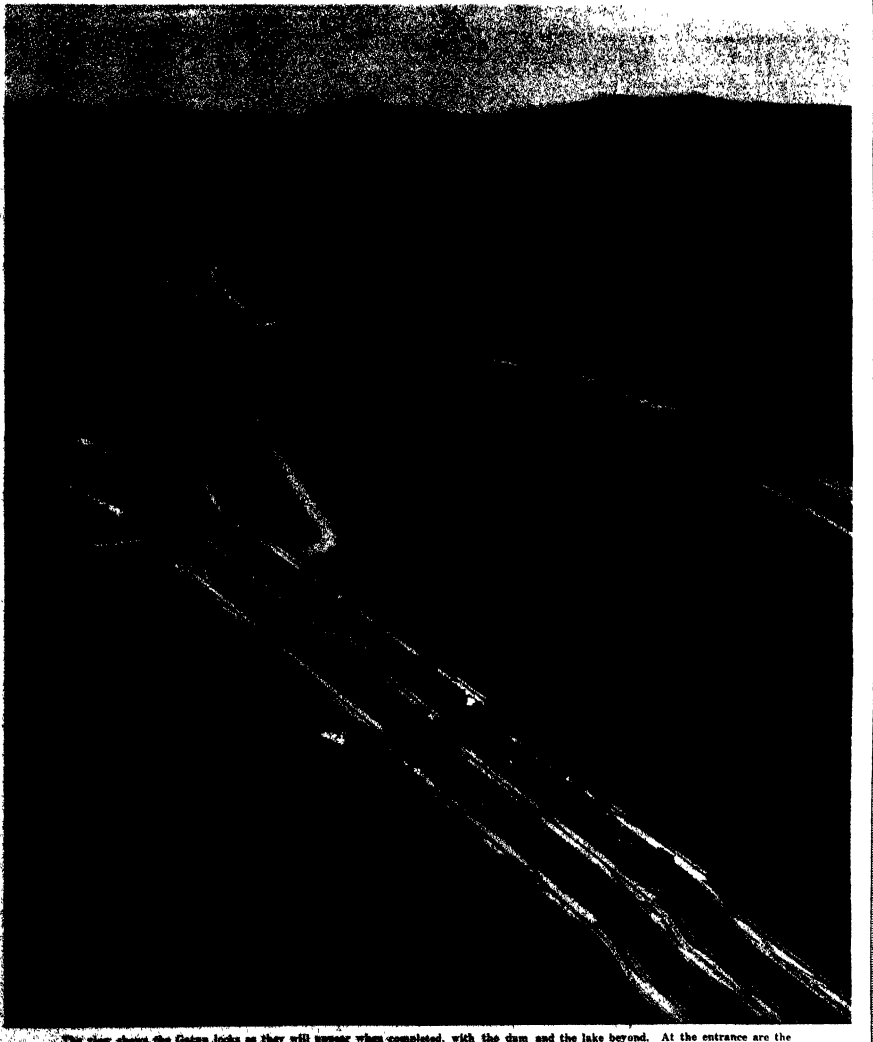
SIXTY-SEVENTH YEAR

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This view shows the Gatun locks as they will appear when completed, with the dam and the lake beyond. At the entrance are the emergency dams. Ships will be towed through the locks by four electric locomotives, running on tracks upon the side and center walls

PROGRESS OF THE PANAMA CANAL IN 1911.—[See page 597.]

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The purpose of this journal is to record accurately, simply, and interestingly, the world's progress in scientific knowledge and industrial achievement.

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Retrospect of the Year 1911

Civil Engineering.

IN any review of the engineering progress of the past year, the construction of the Panama Canal assumes the position of importance. Not alone is this the greatest single engineering work of its kind, but it is notable for the fact that it is being done at an accelerating speed, and will be completed long before the date predicted. In this respect, it stands almost alone among American engineering works of great magnitude. According to the report of the chief engineer, the Gatun dam will be finished during the summer of 1912, the locks at Gatun about the same time, the locks on the Pacific side in the fall of the same year, while the Culebra cut, and the channel entrances on each ocean, will be completed by July 1st, 1913, at which date eighteen months before the time originally estimated, shipping will be able to pass through the canal from ocean to ocean. Next in importance is the New York State Barge Canal upon which during the year satisfactory progress has been made. Practically the whole of the canel is under construction, and both the concrete work at the locks and the work of excavation are being pushed forward at a rate which gives promise that within a few years time this valuable addition to the transportation facilities between the Great Lakes and the Atlantic seaboard will be open for service. The proposed Pittsburgh-Lake Erie canal has been brought again into public notice, and it is now proposed that its cost of fifty million dollars be divided between the three States which are interested, namely, Ohio, Pennsylvania, and West Virginia, the control to be vested in a joint commission. There has been a movement on foot in Russia to build a canal, with a depth of 14 feet, between the Black Sea and the Baltic, utilizing some 900 miles of the bed of the West Dwina and a thousand miles of the bed of the Dnieper. The estimated cost is $150,000,000. The greatest water-supply project in the world, namely, that for bringing the water of the Catskill region to New York city, has made great advance during the past year. The Ashokan dam is nearing completion; work upon the ninety miles of 17-foot aqueduct has been opened up upon many new sections; the wonderful siphon by which the water will be conveyed beneath the Hudson at Storm King is so far advanced that the vertical shafts on opposite sides of the river have been sunk to a depth of 1,200 feet, and the boring of the connecting horizontal tunnel is making good progress. The contracts have been let for the construction of the terminal tunnel which will extend the full length of Manhattan Island at depths of from 200 to 700 feet. Moreover, the prospects are that within a year or two, Catskill water will be fed to the Croton reservoir, whence it will be available for distribution in New York. One of the most beneficent and little-understood works of the United States is the reclamation by irrigation of arid lands. Already there has been invested about sixty million dollars in this work, and during the year it has been increased at the rate of about one million dollars per month. The scheme of reclamation includes the construction of some of the greatest dams and largest reservoirs in existence. Perhaps the most notable event in this work was the dedication of the Roosevelt dam, which was celebrated on March 18th. The structure is 282 feet 8 inches high, and it impounds sufficient water to cover 1,284,000 acres to a depth of one foot. At the present time, water can be supplied to about one million out of the three million acres which the completed scheme will cover. Another great hydraulic work in this country which has been advanced during the year is that of grading the Everglades in Florida, by which a vast tract of fertile swamp land will be brought under cultivation. In the field of bridge engineering, the most notable event was the letting by the Canadian Government of a contract for the construction of a new Quebec bridge to take the place of the one which failed so disastrously a few years ago. The structure will be what is known as the "K" web system, and the cantilevers will carry a Pratt-truss suspended span, 640 feet in length. Nickel steel will be used in the cantilever arms; the suspended span, the anchor arms, and the members immediately over the main pier, together with the floor system, will be built of carbon steel. Toward the close of the year the contract was let for the construction of the four-track Hell Gate bridge, which will connect the Long Island Railroad system with the railroad systems of the main land. The most notable feature will be the main span of 1,000 feet, which will be the longest and heaviest arched span in existence. In the arch bridge alone will be 18,000 tons of steel, and it will take 70,000 tons for the whole structure, whose total length will be three miles.

Electrical Engineering.

During the year, the field of electrical engineering has steadily enlarged its borders. The progress has been in the direction, not so much of the development of new inventions and applications, as in the broadening of the scope of those already established. Undoubtedly, the most notable advance is that which has been made in electro-metallurgy and electro-chemistry. It is sufficient here to note the increasing application of electricity to the electrolysis of salts, the production of metallic aluminium and sodium, the production of calcium carbide, in all of which industries, and particularly the production of aluminium the progress is by leaps and bounds. The refining of metals by electrolytic action has been responsible during the past year alone for placing over one hundred million dollars' worth of pure copper on the market. In the more novel applications of electricity to the arts, the electric reduction of iron ore has been the most prominent, and among the several ingenious designs of electric furnaces there are two or three which give promise of competing commercially with the present gas and coal furnaces. In the field of electric lighting, the tungsten lamp continues to win popular approval; and this can be readily understood when we remember that a 16-candle-power carbon filament lamp requires 56 watts for its operation, whereas a 20-candle-power tungsten lamp demands only 25 watts. It is gratifying to know that during the year the united efforts of the electric lighting companies have succeeded in producing a drawn-wire tungsten filament of great toughness and durability. In the field of transportation, electricity continues to be the supreme power for urban and suburban service, and note should be made of the fact that the Edison storage battery cars which have been operating during the year in New York city have been giving reliable and satisfactory service. The application of electric traction to steam roads is not making the progress which was expected when the New York Central and New Haven installations had proved how reliable and punctual a service could be given. Figures of cost are difficult to obtain; but, as the report on the proposed electrification of Boston suburban roads showed, the first cost of these changes from steam to electric power is so great as to discourage investments of this character. There is a consensus of opinion that the alternating-current, overhead trolley will be used for long distance service, and the direct-current third-rail system for terminal and suburban. The utilization of water powers by the construction of large hydro-electric plants continues to make a... advance, the most notable work of the year being the vast dam which is being built across the Mississippi River at Keokuk, Iowa. The dam will stretch... seven-eighths of a mile across the river, rising 82 ... above the river bed. At one end of the dam will be the lock gates and a power house 1,400 feet in length, in which will be mounted thirty hydraulic-electric units. The initial installation of 120,000 horse-power is to be completed in July, 1913. A promising field for the application of electric power is that of agriculture. It has been shown in the pages of the SCIENTIFIC AMERICAN what possibilities lie at the very doors of the farmer in the many abandoned mills and reservoirs, some of which, by a little reconstruction and adjustment, may be turned into central stations, from which power can be furnished to surrounding farms at a not prohibitive cost.

Railroads.

In the preceding section we have touched upon the progress of electricity as a motive power for steam railroads. The probability of the substitution of electricity for steam on the score of reduced cost of operation has been somewhat lessened by the extended application of superheat to locomotives. It now looks as though superheat will achieve those economies which, at least in American practice, compounding has failed to secure. The simple engine always possessed certain practical advantages over the compound, and the addition of superheat makes it possible to secure equal and often greater fuel economy in a locomotive of the simple type, than is possible in a non-superheat compound. The increasing application of superheat may easily be set down as the most important development in locomotive practice of the past year. In spite of predictions to the contrary, the weight and size of American locomotives, and, to a less degree, of foreign locomotives, continue to increase. To-day, in the huge engines built for the Santa Fe Railroad, we surely have reached the limit. A passenger locomotive for hauling fast passenger trains weighs 188 tons without the tender. The Santa Fe Mallet freight locomotive, with twenty-four wheels, twenty of which are drivers, weighs 308 tons, and with the tender, 425 tons, its length over all being 120½ feet. The fatal wrecking of the Washington express on the New Haven road, near Bridgeport, when it was taking a crossover, has drawn attention to the necessity of making crossovers from express to local tracks longer and of easier curvature, so that they may be taken at high speed without risk of derailment. Notable events of the year were the opening of the Pennsylvania terminal and tunnels at New York and of the handsome terminal of the Chicago & Northwestern at Chicago. Great progress has been made with the Grand Central terminal of the New York Central Railroad at New York. The excavation is nearly completed, and the greater part of the steel work of the station building has been erected. This terminal, with its total area of 69⅜ acres, is equal in area to the four next largest terminals of the world, combined.

The Steam Engine.

In spite of the activity and great promise of its younger competitors, the steam engine, thanks to careful study of its principles and the best methods of construction, seems likely to hold its own as the principal prime mover for many years to come. The steam turbine, from the attitude of a competitor of the reciprocating engine, has passed into the position of its complement or useful ally. It is now understood that in the higher ranges of steam expansion, the reciprocating engine is supremely economical, just as the turbine is in the lower ranges. The installing of a low-pressure turbine between exhaust and condenser of the reciprocating engines, as we showed last year, increased the output of the New York subway power station 100 per cent, and increased the economy 150 per cent. Both on shore and at sea, the economic value of superheat is coming into increasing recognition, and economies of from 20 to 30 per cent and more have been realised in a wide variety of installations. An interesting development was made public during the year in the Tesla turbine, which consists of a series of flat steel disks mounted on a shaft within a casing, the steam being delivered at high velocity at the periphery of the disks and flowing between them in spiral paths, to exhaust through ports at their center. Tesla depends upon the properties of adhesion and viscosity of the steam for securing the desired torque on the shaft. A curious situation has developed in the United States navy, where there is an unmistakable disposition to return to the reciprocating engine as the drive for our future battleships. This attitude has resulted from observation of the sister battleships, "Delaware" and "North Dakota," and the economy of 30 to 40 per cent shown by the reciprocating engines

the "Delaware" over the turbines of the "North Dakota," when the two ships were steaming in column during several thousand miles of cruising. The action of the department is, we consider, rather precipitate. The engines of the "North Dakota" are of a rather early type; more modern turbines would reduce the difference to 20 per cent, and a combination of cruising reciprocating engines and turbines would, we believe, wipe out the difference altogether, leaving the balance of practical advantages heavily on the side of the turbine-engined vessel.

Naval Development.

Toward the close of the year, there was mobilized in the North River, New York, at a few weeks' notice, the most powerful fleet that ever assembled in American waters. Over one hundred ships were drawn up in several parallel lines between the New York and New Jersey shores; and that the object of the Navy Department of popularizing the navy by showing to the people the actual ships themselves, was achieved, was proved by the vast throngs that flocked into the city from the surrounding country to witness the truly majestic spectacle. The most imposing element of the display was the line of twenty-six battleships, extending unbroken for six and a half miles, in which was included the six dreadnoughts that have been completed for the navy. Of more importance, however, than material, is personnel; and the significance of that array could be appreciated only by the naval man himself or by those who, like the writer, had been privileged to live aboard one of the ships of the navy when the fleet was engaged in the regular routine of daily life, and in the supremely important work of battle practice. In discipline, *morale* and practical efficiency, the navy has never stood as high as it does to-day. We have so recently devoted a special number to this subject, that it is sufficient for the purposes of the present review, to refer to the various articles in that issue, written by leading officers of the Department for the purposes of telling the people of the United States just what kind of a navy it is that we possess. The American type of dreadnought, with center-line turrets, and guns firing above the roofs of adjacent turrets, has become standard throughout the world; and the guns so admirably placed are being served so well, that we believe our ships are able to make accurate shooting at ranges that are never attempted by any foreign fleets. The one great fault with our navy is that it is not proportionate to the wealth and responsibilities of the country which it protects. The general board at Washington, after a conservative review of conditions, have decided that, in order to maintain a navy adequate to our wealth and population, we should build four ships (battleships or battle cruisers) every year. Our present inadequate increase of two battleships per year will, in five years' time, make it possible for our nearest competitor among the European naval powers to challenge the Monroe Doctrine, knowing that its strength in dreadnought ships, as compared with our own, is 100 per cent greater

In a general review of naval development, there is noticeable a steady increase in the size of the battleship and the caliber of her guns. The largest ships have reached a displacement of 28,000 tons and over and carry 13.5 and 14-inch guns. There are signs of a reaction in favor of smaller ships, but we doubt if it will take place, so many and so great are the advantages conferred by the possession of big units. A noteworthy feature is the growth in popularity of battle-cruisers, ships of 28 to 30 knots speed, well armed, well protected, and with a large radius of action. We consider that the weak point in the make-up of our navy is its lack of any ships of this class. Our little 25-knot "Chesters" and "Salems" would be as defenseless in the presence of such vessels as so many chickens before a flock of hawks. They would not dare to venture within range of a screen of battle-cruiser scouts; for that would mean capture, or speedy destruction by 12 and 13.5-inch guns. Moreover, a squadron of 28-knot battle-cruisers would prove to be an extremely complicating factor in battle tactics, when used against an enemy which possessed no vessels of this class. The destroyer holds its own, and seems to increase in importance. Four destroyers to each battleship is a standard in European navies which we should make haste to follow. The submarine is increasing rapidly in size, offensive quality, and, most important of all, in sea-keeping qualities and radius of action. It is our belief that the submarine, or some modification of it, will see a development during the next decade which will possibly enable it to challenge the present supremacy of the battleship. Although the existing war between Italy and Turkey is necessarily, because of the practical absence of a modern Turkish navy, a military war, it has served to emphasize in a striking degree the importance of the command of the sea. Italy is not only able to localise the war in Tripoli, but is in a position to completely prevent the sending of necessary reinforcement and supplies to the Turkish army at the seat of war.

The Merchant Marine.

In any American who is possessed of a true patriotism, the subject of the American merchant marine must necessarily beget feelings of regret if not of positive humiliation. Year by year the flag of this country becomes scarcer upon the high seas, and it may truly be said that matters have come to such a sorry pass that unless this nation bestirs itself to a sense of its duties and opportunities, its flag must ultimately disappear from the seven seas. Let the facts of total tonnage speak for themselves. In 1789, the United States possessed 124,000 tons of merchant shipping engaged in foreign trade. In 1809, the total had risen to 667,000 tons. Sixty years later, we led the world, with a total of 2,379,000 tons. In 1910, the total had fallen to 782,000 tons, which is but a little over 100,000 tons more than we had afloat at the beginning of the nineteenth century. The one hopeful sign is the fact that the importance of the subject is continuously impressed upon the public mind. Out of the many suggestions which are being offered for the resuscitation of our merchant marine, there are two which seem to be practical, and would probably prove to be thoroughly effective. The first is the institution of a system of preferential duties in favor of American-built ships and against ships flying the flag of a foreign country. It was under this policy that the merchant marine of the young republic prospered in the first forty years of its existence, and we believe that like causes would produce like results in the present day. The other remedy, which is connected with the opening of the Panama Canal, proposes to bring all American shipping, sailing between Atlantic and Pacific ports by way of the Panama Canal, under the regulations which protect our coastwise shipping. Ocean-going steamships continue to increase in size, and it is an extraordinary fact that the increase is at an accelerating rate. When the "Mauretania" and "Lusitania," each 790 feet in length, were launched, it was predicted that the limit of size had been reached, but during the year there entered the port of New York, on her maiden voyage, a ship which is 882½ feet in length, and which exceeds the displacement of the two great Cunarders by from 15,000 to 20,000 tons, according to the degree of loading. In addition to her great size, the "Olympic" is notable for being driven by a combination of reciprocating engines and turbines. Her speed of 22 knots is, of course considerably less than that of the Cunarders, which must remain the fastest of the trans-Atlantic liners until such time, possibly, as the internal-combustion engine has rendered a further advance in speed possible. The end is not yet, however, in this matter of size. The Hamburg-American Company is building two vessels, the "Imperator" and a sister ship, which are to be just under 900 feet in length, the Cunard Company is constructing the "Aquitania," which will slightly exceed 900 feet; and, in answer to our inquiry, the leading officials of the White Star Company inform us that an order has been placed with the Belfast firm for the construction of an 18-knot ship, 1,000 feet long, 100 feet wide, to be driven by combined turbines and reciprocating engines of 55,000 horse-power. The limit on length and size is placed by the length of piers and depth of harbor entrances, and before the "Olympic" could dock at New York, it was necessary to make a temporary extension of the pier (by permission of the War Department) of 100 feet, which, under the terms of the permit, must be removed in twelve months from the present time. From the earliest days of the modern steamship, attempts have been made to check rolling at sea. The most promising device to-day is that of Frahm, who has installed on several vessels anti-rolling water tanks, which apparently have done much to reduce this unpleasant source of discomfort to the sea voyager. The most important development in marine engineering just now, outside of that of increase of size, is the attempt to utilise the internal combustion engine for propulsion, a subject which is treated at fuller length in the present review under the head of the internal combustion engine. Mention should be made of the effort to reconcile turbine speed with propeller speed by the interposition of an intermediate reducing gear, the most noteworthy of which is the installation on the United States collier "Neptune," a 14-knot vessel of 19,360 tons displacement. The turbine running at 1,220 revolutions per minute, drives the propellers at 185 revolutions, through an intermediate, mechanical-reducing gear of the Westinghouse-McAlpine type, which has shown an efficiency of 98 per cent in a shop test. Trials of this vessel are still in progress. A sister ship to the "Neptune," the "Jupiter," is being equipped with a turbo-generator, running at 2,000 revolutions per minute, the power from which will be transmitted to the propeller shaft, with a speed reduction of 18 to 1, and an estimated efficiency of transmission of 91 per cent. Whether reduction gears or a combination of reciprocating engines and turbines will prove to be the better solution of the marine turbine problem, will probably be demonstrated during the coming year.

Internal Combustion Engines.

In the field of prime movers, the internal combustion engine undoubtedly presents the greatest promise, both as to the wide field of its application and the great reduction in space occupied and consumption of fuel per unit of work done. Although the producer-gas engine has given promising results, both in marine and stationary plants, it is to the heavy oil engine of the Diesel type that the engineering world is looking for immediate developments. Because of its reliability and simplicity of operation, the Diesel engine has won recognition as the heavy oil engine of the future. Nowhere is it holding attention just now so closely as in the navy and the merchant marine. For marine work, it offers many and most valuable advantages. Tests on large engines of this type have shown the remarkable economy of 0.38 pound of crude oil fuel per brake horse-power hour, and the marine engines now in use average from 0.40 to 0.41 pound of fuel per brake horse-power when running under full load. In addition to fuel economy there is the great advantage that the space formerly occupied by the boilers and coal bunkers is free for cargo carrying or on warships for the installation of larger magazine, oil, or, on warships, for the installation of larger magazines and store rooms. The fuel may be piped directly to the tanks and stored in the double bottom, a speedy and cleanly operation compared with the slow and dirty work of coaling a ship. The most notable marine installation is that aboard the vessel which is now being built by the Hamburg American Line for their transatlantic service. This ship of 9,000 tons, will be driven by twin engines, each of 1,500 horse power, with which the ship is expected to develop a speed of 11 to 12 knots.

Astronomy.

By far the most noteworthy astronomical event of the year was the appearance of the new star discovered by Espin. Although the nova was actually first discovered on December 20th, 1910, the phenomenon may fairly be considered an astronomical event of 1911. The star proved to be a typical nova which caused its sudden appearance probably to a collision between some cold, but, in the depth of space and a nebula or cluster of meteoric bodies.

The year was a year of comets. The body discovered by Kiess at Lick Observatory on July 6th was easily visible in an opera glass. Two weeks later, Prof. William Brooks of Geneva, N. Y., the veteran comet hunter, discovered a comet which came within thirty million miles of the earth, and which proved to be a fairly conspicuous object. The return of Encke's comet was watched with interest, because it has the shortest period of any known comet, returning to the sun every three and one-half years. Because it varies in brightness at each successive return in a very remarkable manner, and because its varying period of revolution proves that some other force than the attraction of the sun must act upon it. In the month of September two more comets were discovered, one by the Russian astronomer Bedjawsky, and the other by Quinnesset. Borelli's faint periodic comet, discovered in 1905, was observed on its return at some of the southern observatories.

On April 28th there was a total eclipse of the sun, which lasted almost five minutes, fairly long as solar eclipses go. Since the whole track of the shadow lay in the Pacific Ocean, only a few islands were available as stations, for which reason the number of expeditions sent to observe it were not numerous. The usual observations were made, and no startling new fact was revealed.

Prof. Stebbins of the University of Illinois who devotes his time to making very accurate measures of the brightness of the stars with an apparatus depending upon the change in the electrical resistance of selenium when light falls on it, took up the work of discovering new variables with his instrument. In this work he was successful finding no less than two. Thanks to Prof. Stebbins, we have reached a knowledge of systems such as Beta Aurigæ which it seemed almost impossible to have attained ten years ago.

Dr. Baker and Prof. Wendell showed that the star α Herculis is a close double with unequally bright components, revolving about each other in a nearly circular orbit in a period of 2 days, 1 hour and 15 minutes. Prof. Schlesinger on the basis of the observations of Dr. Baker and Prof. Wendell calculated the masses of the components and showed that its distance from us is equivalent to 200 light years.

Aviation.

Startling advances have been made in aviation during the past year. In the middle of January Eugene Ely flew from San Francisco to the cruiser "Pennsylvania," moored in the harbor, and alighted thereon later returning to the shore. This was the first trip from shore to ship, and return, ever made by an aero-

(Continued on page 608.)

The Methods of Dust Extraction on Cotton-carding Engines

Safeguarding the Workingman's Health

By J. H. Crabtree

THE efficiency of cotton mills is intimately dependent upon the working conditions prevailing therein. Fresh, dustless atmosphere at a reasonable temperature is of paramount importance in promoting the welfare of the workers during their daily occupation.

How to clear the air in certain parts of these mills has for some time occupied the serious attention of employers. Several schemes, more or less effective, have been launched forth, but few have gone beyond the experimental stage. They are either too expensive or impracticable on a large scale.

The common plan until recently was to install fans in each carding-machine has two cylinders, one of which is 4 feet wide and makes 160 revolutions per minute, it follows that in a few hours the wires become surcharged with dust and short fibers. And if they were not stripped of these they would be so glutted with refuse that the machine would fail to do its work. Hence when the carding-engine has been in operation for two or three hours the process is stopped, and the two strippers bring up a cylindrical brush covered with wire bristles. This is placed in contact with each of the cylinders in turn, and revolved at a rapid rate.

The brush strips the wires of nearly all the short fibers which clogged up the interstices. It also roots out the dust and sticks which have been retained in the cotton up to its treatment in the carding-machine. When the stripping-brush has done its work, it is an easy matter to clean it by means of a hand-card. It contains short fibers only; the dust has passed into the air of the room in dense volumes.

Here, then, is the specific function of the new appliances—to prevent this dust pervading the air of the room. This is of greatest importance to the men who manipulate the brush. They must stand in close proximity while the brush is revolving. The volumes of dust pass into their nostrils, and much is unavoidably inhaled. This involves serious risk to the men, and in time, tells upon their physical strength. It is, indeed, seldom that strippers are able to follow their employment to a normal age of say 60 to 65 years. The work induces pulmonary troubles in some men at an early age.

The danger is, to some extent, mitigated where the men adopt the precaution of holding a tuft of clean cotton fiber, pressing it between the lips while stripping. This forms an old-fashioned respirator (Fig. 1), which is used daily by men who have often proved its value. Other men have recourse to specially-designed respirators, which are adapted to facial outline (Fig. 3), and preserve the mouth and nose from contact with dust. The fact that strippers have suffered acutely from their occupation has been definitely proved by investigations in various cotton towns where between 40 and 50 per cent have been found affected in varying degrees.

Fans, exhaust or ipdraught, have doubtless done much to purify the air of carding-rooms; but they do not touch dust-clouds for some time after the dust is generated. The result is that the dust becomes mixed with the air of the room and, after having affected the strippers close by, it is diffused in the room generally, and traverses the area where the women and girls are at work on the spinning-frames. There is a moderate amount of dusty material given off from the frames themselves in cotton mills. This in itself, however, does not occasion either inconvenience or injury. The new methods work on different lines from any before put into practice. Several of these are now in operation, but the general principle adopted is to collect the dust at the point of its generation and remove it by means of trunks to the external parts of the mill-premises or to inclosed dust-chambers.

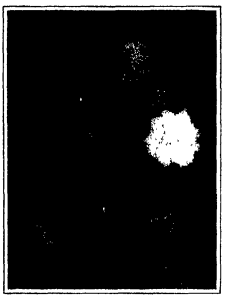


Fig. 1. Simple and primitive respirator. A tuft of cotton held between the lips.



Fig. 2.—Fixed dust extractors in series.

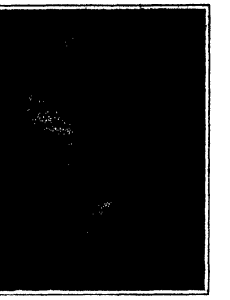


Fig. 3.—Respirator specially designed for use by cotton-mill workers.

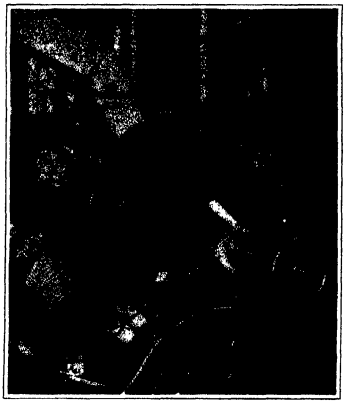


Fig. 4. "Traveling extractor," with stripping brush over the main cylinder of the carding machine.



Fig. 5.—Another form of fixed "dust extractors" in series. When stripping is completed the hood is raised in the vertical tube.

THE METHODS OF DUST EXTRACTION ON COTTON-CARDING ENGINES

of 15 to 24 inch diameter in wall-boxes or window-frames, at various parts of the room, and exhaust the impure or dusty air so as to change the atmosphere of the room three or four times during each day. Dust is generated in most carding rooms in such a degree as to be particularly injurious to the strippers. In card-rooms the raw cotton is combed, in machines known as "carding-engines," by a myriad of pointed wires attached to revolving cylinders.

A roll or "lap" of cotton is fixed on the front of this machine and it issues from the back as a thick woolly band of yarn with the fibers combed in one direction.

This machine makes the first semblance of a thread in the operations of a cotton mill. Between the lap and the thick yarn the cotton is passed over the cylinders covered with wires. Here the short fibers are held between the wires, the dust and small particles of the cotton-plant are also retained here. These millions of wire-points act much like an ordinary clothes



Fig. 6.—"Dust extractors" with automatic valves.



Fig. 7.—"Portable dust extractor."

THE METHODS OF DUST EXTRACTION ON COTTON-CARDING ENGINES

Several plans are at work in the cotton districts of Lancashire. By one of these (Fig 2) a dust-receiver is fixed over each carding-machine. This is as wide as the machine itself and has an opening about 2 inches wide; it bears a balanced lid by which the aperture can be opened and closed at the will of the stripper. The receiver is attached above to a carrier-tube running to the main air-trunk. In this an inclosed blower runs at 1,200 to 1,500 revolutions per minute. The blower will take care of forty to sixty carding-machines, and the additional mechanical power used is nominal.

The *modus operandi* is as follows: When the strippers place the revolving brush on a carding-machine, the receiver-lids of the whole series are closed except the one over this particular machine. Thus the total exhausting force of the blower is concentrated on one machine; and when the stripping begins, the air-currents about the aperture are strong enough to gather the dust as it is generated. The attendants require no cotton tufts or respirators, the dust is completely prevented from reaching their breathing organs.

Then the receiver-lid is closed, the brush removed to the next machine, another lid opened, and the process is repeated throughout the series of fifty or sixty machines.

Another method (Fig 4) has been devised, in which a single traveling receiver is available for each row of carding-machines. In cotton mills generally these machines are laid in parallel lines of ten to forty, with intervening spaces of 10 to 18 inches. It is therefore possible to build up carrier-tubes in line with the machines, and about four feet above them. On either side of the tube-line a rail is fixed to hold the grooved wheels of the traveling receiver.

The exhaust in this arrangement is maintained by a blower running at about 1,300 revolutions per minute. Over each carding-engine is an aperture in the

(Continued on page 404.)

New Tide-predicting Machine

By M. H. Talbott

UNCLE SAM'S new tide prophet is a machine which outclasses all human competitors; it is capable of doing in one day work which formerly required the services of sixty-five computers. It was invented by Mr. E. G. Fisher, of the United States Coast and Geodetic Survey, and is used to predict the height of the water at any instant on any date from one to two years in the future for every port in the United States and seventy of the principal ports of the world. This information is issued in the form of a book by the Coast and Geodetic Survey.

Tide predictions are based on local as well as astronomical conditions that influence the rise and fall of the ocean. At every port in the world there is an instrument which indicates these fluctuations by a curved line on a sheet of paper, and from a long series of such observed curves computers have evolved the average of each component at each place. The formula upon which this perfected machine is based includes thirty-seven of these components. There are a set of gears to represent the sun's influence, another to take the place of the moon, various other sets which act for the planetary movements, and still other sets which speak for local conditions.

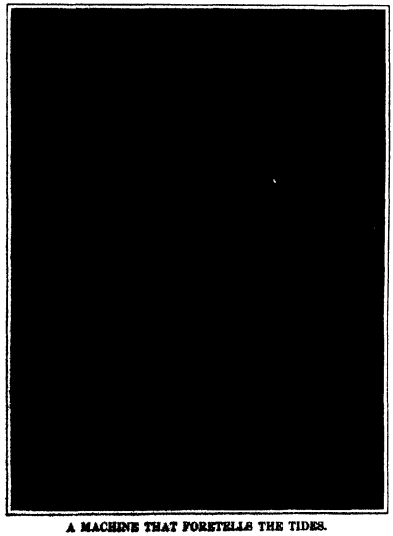
The machine looks like a huge printing press. A skeleton frame of brass, steel, and iron occupies a space 11 feet long, 6 feet high, and 2 feet wide, and from the dial indicators in the front to the opposite end it is a maze of wheels, gears, pulleys, and chains.

There are three hundred gear wheels and pulleys in the machine. These are arranged in two main sections, one representing the time, the other the height of tide. Two chains, each permanently fastened at one end, run through each section, and their free ends are attached to indicating devices.

The operator beginning a set of predictions adjusts the eccentrics connected with each set of gears. By turning a crank he causes the wheels to rise or descend, thus lengthening or shortening the free end of the chain. This variation appears on the dials at the front of the machine, one pointer showing the height of water in feet and tenths; the other the day, hour, and minute of the occurrence. An electrical device stops the machine whenever a high or low water is indicated.

While the operator is recording these figures, the machine is doing a still more detailed work. A strip of paper 6 inches wide and 380 feet long is moving automatically across the face of the machine, and while one pen is marking the hours and exact times of highest and lowest waters, another pen is tracing a curved line which shows the gradual rise and fall.

The information turned out by this machine is sought by the marine engineer who wishes to calculate for improvements, and the hydrographic surveyor who is laying plans for future surveys, as it enables him to know the depth and time of high and low water on any date a year or two in advance.



A MACHINE THAT FORETELLS THE TIDES.

Weighting of Silk

IT is much to be regretted that many unscrupulous manufacturers resort to weighting or "loading" raw silk in the dyeing process, to such an extent as to render it a very uncertain and treacherous fabric with a tendency to split and crack even when carefully folded and laid away. In this dyeing process the natural gum of the silkworm is first removed from the silk by a method of "stripping," as it is called, in order that the raw material may properly take and hold the dye. This causes a loss of weight which dyers have always sought to restore, but instead of being content with doing this, the thrown silk is dipped into a solution of bichloride of tin, nitrate of iron, or some other chemical compound for the purpose of giving it more weight than that lost in the stripping process, so that a hundredweight of silk in the raw state is often made to weigh three, or even four hundred pounds when the dyeing is completed. As raw silk is bought and sold by the pound, the gain to the manufacturer is obvious. This operation makes the silk more valuable, but destroys the durability of the filaments.

Stretching the threads by steaming, so that a given weight will weave a greater number of yards, and the addition of chemicals to give it an unnatural luster are other processes that prove profitable to manufacturers, but costly to consumers.

It is a mistaken idea with many people that the heavy silks are the best and most durable. Just the reverse is true. The light weight, or "pure dye silks" as they are termed, are much stronger and more durable, as only enough added weight is given to this class of silks, in the dyeing, to replace the loss in the stripping process.

The use of inferior and destructive dyes is another method equally as common and equally as reprehensible, by which many manufacturers impose upon the consumers in the dyeing of silk.

Charles Edwin Bessey

The New President of the American Association for the Advancement of Science

By Marcus Benjamin, Ph.D.

AFTER an absence of eight years the American Association for the Advancement of Science returns to Washington for its annual meeting. In 1903 the presiding officer was the chemist, Ira Remsen, who still guides with consummate skill the fortunes of the Johns Hopkins University. At the present meeting a botanist, who for forty years has faithfully attended the gatherings of the Association, will preside over its proceedings.

Charles Edwin Bessey was born in Milton Township, Wayne County, Ohio, on May 21st, 1845. His ancestry on his father's side is of French origin; for the Besseys, as the name was formerly written, were Huguenots who fled from their native country to England and then about the middle of the eighteenth century Jacob Bessey came to America, settling near Doylestown, in Pennsylvania. In 1832 his grandson Adnah moved with his parents to Wayne County, Ohio, where later he married Margaret Ellenberger, of German descent, and there the son was born.

Young Bessey received his earliest education in the public schools of Ohio, and after preparing for college in the academies in Seville and Canaan he entered the Michigan State Agricultural College in Lansing where he was graduated in 1869 with the degree of Bachelor of Science, and where three years later he received a Master's degree. His intention on entering college was to become an engineer but he was advised to specialize in botany, which advice he reluctantly accepted. After much reflection, on so informing the president he was told: "Well, Bessey, I am glad of it, but you'll never be rich," and then a moment later, "Yes, I am glad of it, but you'll never be rich." After graduation he was able to study his chosen specialty at Harvard, where he was fortunate in coming under the influence of Asa Gray from whom he acquired the foundations of the knowledge of systematic botany, especially in its philosophical aspect.

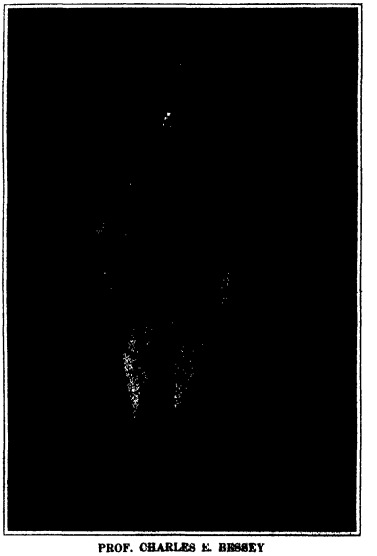
Preferment in those days was naturally in the direction of teaching and in 1870 he was called to the chair of botany in the University of Iowa where he continued for fifteen years, serving also as acting president during the year 1882. He accepted a call to a similar charge in the University of Nebraska in 1884, where he has since remained, being also head of the department. During 1885-1891 he was acting chancellor of the university, and again held this high office during 1899-1900 and during 1907-1908. He was dean of the Industrial College of the University of Nebraska during 1884-1888 and again since 1895; also during 1888-1891 he was dean of the College of Literature, Science and Arts of that university.

While botany has been his favorite study it has not been his only interest; for as he says, "In Iowa I began at once to write for the agricultural papers, telling people how to plant and what to plant, telling them about weeds and grasses, telling them also about insects and their bad habits, for entomology was one of my studies at that time." He joined the Iowa State Horticultural Society and read a paper on harmful insects, and took part in the first Farmers' Institutes held in Iowa during the winter of 1870-1871. On moving to Nebraska he was equally interested and at once began to collect information on the grasses of the State, reading a paper on the subject before the Farmers' Alliance, also presenting papers before such organizations as the Fine Stockbreeders' Association, Dairy Men's Association, Beekeepers' Association, State Agricultural Association, and the State Teachers' Association.

His literary activity has been very great, for besides many contributions to technical journals and papers read before scientific organizations he was for years botanical editor of the *American Naturalist* and has held a similar relation to *Science*. He was the editor of the botanical contributions, most of which he wrote himself, that appeared in the later editions of the New Universal Cyclopedia. Also he edited McNab's "Morphology, Physiology, and Classification of Plants" (1881). His principal works in book form are: Geography of Iowa (1876), Botany for High Schools and Colleges (1880); The Essentials of Botany (1884); Elementary Botanical Exercises (1892), Elementary Botany (1904); Plant Migration Studies (1905); and Synopsis of Plant Phyla (1907).

In honors, he has received elections to the Phi Beta Kappa and Sigma Xi societies, organizations in which membership is restricted to those who have done something. The degree of Ph.D. was conferred on him by the University of Iowa in 1878 and that of LL.D from Iowa College in 1898. It may also be mentioned that he is a trustee of Doane College and he is a member of the Schoolmasters' Club.

Prof. Bessey is a member of many scientific and educational societies, as shown by the following list of organizations, in all of which he has been a prominent officer. He is a life member of the Botanical Society of America and was its president in 1896-1897; also he is a member of the National Educational Association, serving it as vice-president in 1896; and he is a member of the American Microscopical Society, of which he was president in 1902. His connection with the American Association for the Advancement of Science began with his election to membership at the Dubuque meeting in 1872. He was advanced to the grade of fellow in 1880, and has served the Section of Botany as chairman with the rank of vice-president, at the meetings held in 1890, 1902, and 1908. His long and valued connection with this foremost scientific organization in the United States gained for him the well deserved recognition of an election to its presidency at the meeting held in Minneapolis last December.



PROF. CHARLES E. BESSEY

President of the American Association for the Advancement of Science.

Opinions and Beliefs in Science

AS scientific experiments cannot be reproduced, authority necessarily remains our principal guide. In a remarkable book which bears the title "Opinions and Beliefs," the well-known French scientist, Gustav Le Bon shows how large a part mere hearsay plays in scientific investigation. A scientist never publishes results which he does not suppose to be exact, but the influence of suggestion is so strong that even regarding very precise facts, an intelligent person may come under an illusion and take the visions of his imagination for realities. One of the most striking of this kind is the mischance to which nearly all of the members of the Academy of Sciences were victims about forty years ago. On the faith of an eminent mathematician, the assembly inserted in its proceedings about a hundred letters supposed to be written by Newton, Pascal, Galileo, and others. These had been made entirely by a forger of little education and were full of vulgarities and errors, but the names of their celebrated authors and of the scientist who presented them caused them to be accepted. Most of the members had no doubts about their authenticity up to the day when the forger avowed his fraud. When the prestige had vanished, the style of the letters was pronounced wretched by the same persons who before had praised them highly.

The recent adventure of the N-rays is even more typical, and brings out not only the rôle of prestige, but also of suggestion and mental contagion. Heretofore we have to do not merely with experiments which are taken as faith by those who have no opportunity to verify them, but also with observations declared to be exact by a very large body of scientists who claimed to have repeated them. M. Blondlot, a leading professor of physics, observed, as he thought, that many bodies gave out special rays, which he called N-rays. These were detected mainly by their action on phosphorescence. Their wave-length could be measured very closely. What is most singular is that most of the French scientists working in this field repeated his experiments and saw exactly what was suggested to them to see. For two years the Academy proceedings were full of reports from scientists such as J. Becquerel, Broca, and Bichat on the wonderful properties of the rays, and Prof. D'Arsonval, among others, delivered lectures upon them. The French Academy wished to recompense such an important discovery, and delegated a committee headed by M. Mascart to make an official examination of the author's researches. The committee were much impressed, and thus a prize of $10,000 was awarded to the author.

During this time, however, foreign scientists who did not come under the prestige of the French savants, tried in vain to repeat the experiments. Then several of them decided to go to the author's laboratory to observe them. They soon found that he was the victim of a most complete illusion, for he would continue to make measurements of the supposed deflections of the rays, even when the "deflecting" was surreptitiously removed. The matter was carefully examined by a number of scientists, with the result that the specter of the N-rays was laid, once for all.

A few years ago an assistant in Prof. Lippmann's laboratory at Paris claimed to have discovered that an electrified body in movement did not deflect the magnetic needle (contrary to Rowland's experiment), a result which would have been of the highest importance for the theory of electricity. The author was not well known, but as the work was done in the presence of Prof. Lippmann, he had the benefit of his authority, and the question was discussed by physicists until a foreign scientist proved that the conclusions were erroneous and showed the reason why. In the case of the exact sciences the truth comes out sooner or later, as we have to do with real measurements and close observation. It is not the same, however, for sciences which are in a less developed stage, such as medicine; here it is very difficult to verify results, for we do not know what effects are to be attributed to suggestion or to the remedy itself, so that the errors persist for a much longer time. To enumerate them would be to go over all the history of medicine and show that theories, remedies and reasoning change every quarter of a century. About fifty years ago, the treatment of pneumonia by blood-letting was considered in France as one of the fine conquests of medical art, and its value appeared to be proved by statistics, which showed a mortality reduced to 30 per cent. Then the remedy held its place until a doctor who visited a homeopathic hospital at London found that the mortality there did not exceed 5 per cent. This was a revelation. Instead of using diluted remedies, none at all were used, and soon the mortality in France fell to the same figure. To-day, instead of weakening the patient by blood-letting, he is strengthened by alcohol stimulants. This is a good example of the change in expert opinion. There is no need to multiply the examples, and it seems evident that the greater part of our scientific opinions should not be termed knowledge, but rather belief.

A Laboratory for Manufacturers

A German Scientific Institution That Tests a Manufacturer's Raw Material and Products and Gives Him Scientific Advice

By Waldemar Kaempffert

THIS is the first of a series of articles intended to show the part that science plays in German industry and commerce. The author of the article, Managing Editor of the SCIENTIFIC AMERICAN, *was sent to Europe by the publishers to study German industrial conditions with this object in view.*

A Saxon manufacturer of silk cravats found that his orders were steadily diminishing, although the season and the market were both in his favor. He made an investigation and discovered that his customers were buying silk cravats from a Prussian manufacturer at a price fifty per cent less than that at which he could produce them. To the Saxon's eye and touch the cheaper cravats were as good as his own. He could detect nothing in the material that could explain why cravats exactly the same in appearance should be sold at two widely different prices. He spent a month in thoroughly overhauling his factory. He found that he was buying his raw material at the lowest possible prices, that his wages were not higher than they should be; that his overhead charges were not excessive, and that his organization was good. Yet the fact remained that the Prussian was underselling him and was apparently making money.

The Saxon was an expert in cravats—at least he thought he knew all about them, because he had been making them for the better part of his career. Yet for the life of him he could not explain why it was impossible for him to compete with the Prussian. One day a salesman of his suggested that it might be well to have the Saxon and the Prussian cravats scientifically compared by the Koenigliches Material-Pruefungsamt—the Royal Laboratory for Testing Materials at Gross Lichterfelde, near Berlin. The examination would cost but little and might explain the mystery. As a manufacturer, the Saxon was convinced that he knew more about cravats than any scientist in any government testing laboratory, and that his trained eye and his sensitive thumb were more to be relied upon than lenses and chemicals. Still he consented. Samples of the Prussian and Saxon cravats were sent to Gross Lichterfelde. Two weeks later he received a formal report. His own cravats were pure silk. The Prussian's cravats were half genuine silk and half artificial silk (nitro cellulose). A chemist and a microscopist, neither of whom had ever made a cravat in his life, had not only discovered in an hour or two a deception that a manufacturing experience of thirty years had failed to note, but even revealed what particular process had been used in making the artificial silk employed.

The Technical Problems of Commerce.

It would not be difficult to relate a hundred instances such as this, all of them typical of the work done at the most remarkable testing laboratory in the world. At Gross Lichterfelde I saw not only cravats undergoing a rigorous scientific investigation, but chains, girders, paper, textiles, wood, dyes, copper, rubber, ink, typewriter ribbons—almost every kind of material that is used in our daily lives. Sometimes, as in the case of the Saxon manufacturer of cravats, the manufacturer was puzzled by a rival's success; sometimes he found himself with oxidized metal or faded goods on his hands, unable to discover the cause of the defects; sometimes he thought the customs officers had wrongly appraised his importations, because they had misjudged the character of the material; sometimes he wanted to know which of several raw materials should be employed for a specific purpose and was unable to decide himself.

The Royal Laboratory for Testing Materials works hand in hand with the German industrial. For a sum of money that must seem slight to Americans it places at his command a staff of two hundred and twenty-two men, seventy-two of whom are technically trained and the highest authorities in their respective departments of science. These men have at their disposal an equipment that includes the best obtainable apparatus for testing and analysing any given material.

In Germany, indeed in Europe, the Laboratory is regarded as a court of last resort in matters involving the application of science to business. It is frequently difficult for a scientific man in the employ of a large corporation to deliver an absolutely impartial opinion on his firm's product. Inevitably there is a tendency to underestimate the products of a rival manufacturer and to view his own with favor. There is no such tendency in the Royal Testing Laboratory. There, likewise, every engineer, every microscopist, every physicist, is a government official, and, as such, he is enabled to assume an absolutely impartial and judicial attitude toward the problem given him for solution. Indeed, impartiality is insisted upon, not only in the testing and examination of materials, but also in the phrasing of the reports submitted to an applicant for information. The manufacturer who can use one of the Royal Testing Laboratory's colorless opinions for advertising purposes would be miraculously ingenious. To restrain him, however, from exercising too freely what average ingenuity Nature has endowed him, and to prevent him from quoting with approval a report which is many years old and not at all applicable to his present goods, the Director of the Laboratory refuses to furnish certified copies of opinions more than one year old, and sometimes goes to the trouble of checking up advertisements in which reference is made to the favorable opinion of the Royal Testing Laboratory.

Scientists Who Study Factory Methods in Factories.

In order that the Laboratory may keep in close touch with industrial developments, members of its staff are sent from time to time to factories in order to study the exact manner in which textiles, cement, paper, ink, and the like are made. Thus, when it was decided to elaborate the equipment for testing caoutchouc and electric insulators, the exact manner in which rubber goods are made industrially was carefully studied, so that machinery could be designed which would enable a chemist or physicist to determine those facts which would be most useful to a rubber manufacturer. What manufacturer, for example, can tell definitely whether or not rubber goods should be stored in moist or dry rooms; whether that room may be indifferently hot or cold, dark or light; whether a rubber strip should be stored stretched or unstretched? These and similar questions Gross Lichterfelde will soon answer for him definitely, as the result of a long series of most practical experiments.

German manufacturers have not been slow to recognize the immense value of a government laboratory which solves for them the technical problems of commerce. A number of manufacturers of electric insulating materials jointly supplied the necessary funds for a painstaking study of insulating materials and of the insulating properties of rubber substitutes. The many compositions submitted were tested at various temperatures to determine their readiness of manipulation in the factory, their behavior under tension, torsion, and traction; their hardness; their ability to withstand exposure to weather and chemical corrosives. When the results of these studies are published the Society of German Electro-Technicians will frame specifications for electric insulating materials, in which for the first time some admirable substitutes for rubber will receive their due.

How very impartial is the attitude assumed by the Laboratory is apparent when it is considered that manufacturers of competing materials may appeal for scientific information to Gross Lichterfelde at the same time. Sand-lime brick and clay brick are competitive building materials. Yet a powerful association of sand-lime brick manufacturers and an equally powerful association of clay brick manufacturers simultaneously consulted Gross Lichterfelde for the purpose of improving their respective bricks. The comparative tests which were made proved immensely valuable to both associations and gave the ultimate consumer a far better building material than he would otherwise have been able to purchase.

Perhaps the Laboratory has done its most efficient work in co-operation with the technical associations of Germany—associations of engineers, manufacturers and technical men. Thus in conjunction with the Society of German Cement Manufacturers, the Laboratory conducted an exhaustive investigation which has resulted in a scientific standardization of Portland cement, and has definitely settled such nice points as the influence of high temperature on concrete, the effect of copper, lead and zinc on cement, and the comparative merits of Portland cement and iron slag Portland cement. Similarly, in co-operation with the Society of German Bridge and Structural Iron Builders, a painstaking study of the strength of rivets in steel girders was made.

A Study of Paper and Ink.

It must not be supposed that all German manufacturers have been broad-minded enough to submit their products to Gross Lichterfelde for approval. An attempt to analyze the various kinds of automobile gasoline sold throughout the German Empire and to induce the wholesale dealers in gasoline to standardize liquid fuel so that the motor car owner could buy gasoline in Southern Germany exactly similar in quality to that sold in Northern Germany, was met by a flat refusal on the part of the dealers to assist the Laboratory. It is only a question of time when the Laboratory will succeed in carrying out its plan. Similar opposition was encountered when Gross Lichterfelde was commissioned by the government to analyze German papers and to determine their availability for bank notes, public documents and the like; an opposition that may be understood when it was discovered that only a very small percentage of German papers were found to answer the government's requirements. As the result of the work done at Gross Lichterfelde the German paper manufacturer has so far improved his product that rarely indeed has he failed to fulfill government conditions. Opposition to the scientific investigations of the Laboratory has given place to the heartiest co-operation.

It was but natural that after paper was studied for the government the thousand and one inks sold in the German market should have been carefully analyzed and tested to determine their chemical composition and their ability to withstand light, fire, and weather. That investigation has only recently been completed. The government can now specify with scientific precision the characteristics of a wellnigh perfect ink to be used on its wellnigh perfect paper.

The standardization of manufactures is thus undertaken only for the government. The Laboratory as a government institution entrusted with the scientific examination of material used by the government can dictate the requirements which that material must fulfill, but it would not set up standards for the manufacture of articles for ordinary consumption. When a manufacturer requested the Laboratory to determine for him the qualifications that an asphalt should have for insulating purposes, he was told that the asphalt industry must frame its own standards but that the Laboratory would assist him by giving scientific advice.

A Scientific Court of Last Resort in Technical Disputes.

As an impartial institution for scientifically passing upon the commercial availability of manufactured products, Gross Lichterfelde is required by law when requested to do so, to settle technical disputes. Instead of wasting time and money in asking the courts to decide whether or not a contract has been carried out according to the spirit and the letter, the disputants often submit their case voluntarily to the Laboratory for decision. A builder ordered a large quantity of roofing tiles and specified that they were to be waterproof. When the tiles were delivered he refused to pay for them on the ground that they failed to comply with the conditions of the contract. The dispute was submitted to the Laboratory for decision. The tiles were tested and it was found that they were sufficiently waterproof to come within the meaning of the contract.

Even if a case does go to court, the Laboratory may be asked by the presiding judge to decide the technical point at issue. The decision is binding upon both sides—a veritable boon to a court confronted with a mass of conflicting expert testimony. In one case it appeared that in the construction of a wall a stone composed of crushed slag had been employed together with lime mortar. The mortar failed to harden. The dealer who had delivered the slag stone insisted that the wrong kind of mortar had been employed. The mortar maker retorted that the slag stone was worthless. The experts summoned by both sides failing to agree as might be supposed, the court submitted the whole matter to Gross Lichterfelde. There it was decided that the mortar had failed to harden, not because it had been made with the wrong kind of sand (as one expert had declared) nor because the slag was of the wrong kind (as another expert had insisted), but because many lime mortars harden only when exposed to the air, and then only after they have been alternately moistened and dried. Hence, said Gross Lichterfelde, the core of a wall, as in the case in question is not likely to harden at all, whether or not a slag stone or good brick is employed.

In another case the court called upon the Laboratory

(Continued on page 508)

The Heavens in January

Constellations of Southern Skies

By Henry Norris Russell, Ph.D.

THE star-maps published every month in the SCIENTIFIC AMERICAN represent the sky as it appears to an observer in the latitude of New York (approximately 40 degrees north) and consequently fail to show the stars within 40 degrees of the south celestial pole, which are visible only in lower latitudes.

To meet the needs of observers in the southern part of the United States or in more southern countries the accompanying map has been prepared showing all the stars clearly visible to the naked eye within 60 degrees of the south pole.

The whole region of the heavens here represented can be seen at once only from points in extreme southern latitudes. From stations north of the equator less than half of it is visible at any one time. It is, however, very easy to adjust the map so as to show just what southern stars are in sight from any given station, at any day and hour.

We need only know the observer's latitude (which can be obtained with sufficient accuracy from any good atlas) and the sidereal time. The latter can be found closely enough for our purpose by adding together three numbers: 1, the local time as given by an ordinary clock; 2, the quantity given in the accompanying table for the current month; 3, four minutes for each day of the month to date.

	h	m
January	18	20
February	20	44
March	22	32
April	0	34
May	2	32
June	4	34
July	6	31
August	8	35
September	10	37
October	12	35
November	14	38
December	16	36

Midnight should be counted as 12 hours, 1 A. M. as 13 hours, and so on, and if the sum exceeds 24 hours, this amount should be subtracted from it. For example, for 1 15 A. M. on October 25th, we have:

	h	m.
Clock time	13	15
From table, for October	12	35
4 × 25 = 100 minutes, or	1	40
Sum	27	30
Subtract 24 hours	24	0
Sidereal time	3	30

The results of this calculation will be correct within four or five minutes at the most if the observer's clock keeps local time. If it keeps standard time, the result should be corrected by the amount by which standard time is fast or slow of local time. For our present purpose, this correction is usually hardly necessary.

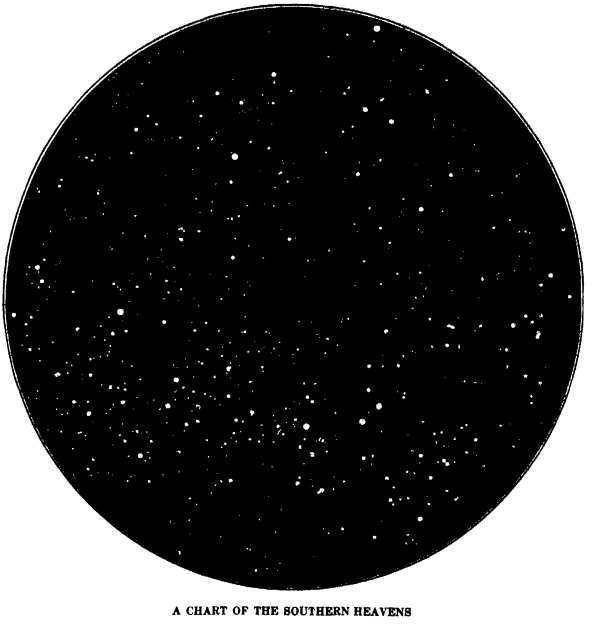
Find now the point on the margin of the map corresponding to the sidereal time, by means of the scale of hours and minutes on the edge, and turn the map till this point is at the top. Then lay a straight edge across it so that it passes above the center at a distance equal to the observer's latitude (if north of the equator). As the white circles on the map are 10 degrees, 20 degrees, 30 degrees, etc. from the center, this can be done very easily. The part of the map above the straight edge then represents the southern sky, as it appears above the observer's horizon. In strict accuracy, the line representing the horizon should be curved, so as to be about one-third nearer the horizontal diameter of the map at the edges than at the center; but this too is of small practical importance.

For stations south of the equator, where the south celestial pole is above the horizon, the straight edge should be held below the center of the map, at a distance equal to the latitude. Stars in other parts of the sky than the south may be identified by the aid of the maps published every month. The present map is purposely made to overlap the southern portions of those by about twenty degrees, to facilitate passing from one to the other.

The familiar aspect of the northern heavens on a winter evening needs little description.

Orion and Canis Major blaze in the south, with Argo on the horizon below them. Gemini and Canis Minor are east and southeast of the zenith, Auriga directly overhead, and Taurus southwest of him. The planets Mars and Saturn, near together, between Taurus and Aries, increase the brightness of what is at all times the most brilliant region of the starry sphere.

Hydra, Leo, and Ursa Major are conspicuous in the eastern skies; Draco, Ursa Minor, and Cassiopeia in the north, and Perseus and Andromeda in the northwest. The only really dull region is in the southwest, which is filled rather than illumined by Pisces, Cetus, and Eridanus.



A CHART OF THE SOUTHERN HEAVENS

The Planets.

Mercury is morning star all through January. He is best seen about the 15th, when he is nearly 24 degrees from the sun. Being far south of the equator, in Sagittarius, he rises relatively late, about 5.45 A. M., but he can be readily seen, before dawn, appearing as a star about as bright as Vega. Venus is likewise morning star in Scorpio, rising about 4 30 A. M. in the middle of the month. Jupiter is a morning star, too, in the same region of the sky. On the 9th the two planets are in conjunction. Venus, which is about 1½ degrees north of Jupiter, appears about eight times as bright to the eye as he does, but in the telescope shows a disk little more than half as big. This very great difference in the apparent brightness of the surfaces of the two planets does not arise from differences in their reflecting power, but from the fact that Venus being relatively near the sun receives about fifty times the strength of sunlight that Jupiter does.

Mars is in Taurus, not very far from the Pleiades, and comes to the meridian at 8 P. M. in the middle of the month. He is rapidly receding from the earth, being 65,000,000 miles away on the 1st, and 88,000,000 on the 31st, and in consequence he diminishes steadily in brightness. At the beginning of the year he is two as bright as Arcturus, and excelled only by Sirius, but at its end he is hardly equal to Capella.

Saturn is in Aries, about 10 degrees west of Mars, and appears about as bright as Procyon. His distance from the earth is so great—over 800,000,000 miles—that the forty millions by which it increases during the month makes but a small percentage of change in his apparent size and brightness.

Uranus is in conjunction with the sun on the 20th, and is invisible throughout the month. Neptune is in opposition on the 13th, and is well observable throughout the month. His exact position may be found at any time by interpolation between the two places:

	h m s.	deg. m.
Dec. 31..	7 37 58	+ 20 57.2
Feb 1 .	7 34 13	+ 21 6.2

This puts him very near the line drawn from β Geminorum to a point found by carrying a line from β Geminorum through κ, and as far again. He appears as a star of magnitude 7.6, and can only be seen with telescopic aid.

The Moon is full at 7 A. M. on the 4th, in her last quarter at 2 A. M. on the 11th, new at 5 A. M. on the 19th, and in her first quarter at 3 A. M. on the 27th. She is nearest us on the 4th, and farthest away on the 17th. As the full Moon comes almost exactly at the time of perigee, we may expect unusually high—and low—tides on and about the 4th.

The Moon is in conjunction with Mars on the morning of New Year's Day, and an occultation is visible, in the morning hours, from points in the southwestern portion of the United States. She is also in conjunction with Neptune on the 4th, Jupiter and Venus on the 15th, Mercury on the 17th, Uranus on the 19th, Saturn on the 27th, and Mars again on the 28th, when a second occultation may be seen in the extreme north of this country.

A comet, visible in a small telescope, was discovered by the French astronomer Schaumasse on November 30th. It is moving slowly eastward through the northern part of Virgo, and increasing in brightness. On January 1st it will be in about 15 hours 15 minutes R. A. and 2 degrees south declination, moving about 1 degree east and 15 minutes south per day.

The first calculation of its orbit (by the discoverer and an associate) shows that it is still approaching the sun, and will not reach perihelion till February 5th, at which date it will be 108 million miles from the sun, and rather more distant from the earth. It will never be very near us, and in consequence may not be at all conspicuous; but it will be observable in the morning sky for some three months to come.

Princeton University Observatory.

Largest University in the World

REGISTRATION, now complete at Columbia University, shows that the attendance upon the university courses for the scholastic year is 7,468 as compared with 6,842 last year, an increase of 626, and, including the extension courses, the number is only eight short of 8,000. This places Columbia at the head of all other universities in the world in point of attendance, taking the place of Berlin, which stood at the head last year.

Progress of Work on the Panama Canal

Prospects of Completion by July 1st, 1913

THE original estimated date for the completion of the Panama Canal was January 1st, 1915. The work has advanced so rapidly that it has become apparent that the canal can be used at least a year earlier than this date. In order to determine the approximate time when shipping could pass through, a board was convened during the past year, composed of those charged with the work in progress and contemplated. Announcement was made that concreting of the locks at Gatun would be finished by June 1st, 1912, and the locks on the Pacific side four months later. Assuming that the gates were completed by June 1st, 1913, the contract time, the locks would be ready on that date, if the operating machinery were installed. The Gatun dam, it was estimated, would be finished by the close of the dry season 1912-1913, and if no more material, due to slides, had to be removed than was estimated at the time the board met, it was decided that the Culebra cut would be completed by July 1st, 1913. The exterior channels leading to the canal from the two oceans, it was found, would be sufficiently advanced to pass such shipping that would use the canal, by this same date, July 1st, 1913.

The report of Col. George W. Goethals, chairman and chief engineer, shows that progress during the past year has been eminently satisfactory. At Gatun locks, by the end of the fiscal year, the skeletons of four leaves of the gates were in position for a height of four panels, and those on the east chamber were completely riveted. At all of the locks, fender chains are to be placed 500 feet above and 230 feet below the upper and lower guard gates. When in use, they will be raised to the surface of the water, forming a barrier to the passage of ships. When it is struck by a vessel, the chain pays out against a resistance provided by hydraulic cylinders. The energy of a 10,000-ton ship moving four miles an hour will be absorbed after it strikes the chain before it reaches the gate.

Contracts for emergency or movable dams to check the outflow of water should the gates be carried away, have been awarded for $2,238,968, and all of these dams are to be completed by June 15th, 1913. Studies are being made of an electrical plant for operating the canal after completion, which contemplates a hydro-electric station on the Gatun dam, and a steam reserve generating station at the Miraflores locks.

A scheme for lighting the canal has been adopted. It contemplates the use of range lights for establishing the direction on the longer tangents, and of side lights, spaced about a mile apart, to mark each side of the channel. The project calls for the construction of 34 tower beacons of reinforced concrete, 57 beacons, 57 gas buoys, 76 spar buoys, and 7 nun buoys. There will be two parallel sailing lines marked by range lights, which will be 250 feet apart, so that two passing ships, if on their ranges, will be 250 feet apart, center to center of ships.

Atlantic Division.

At the Gatun locks the excavation has been completed, except for a small amount at the north end of the lower locks. The concreting plant has shown great efficiency and capacity. The unloading cables have handled 500,550 cubic yards of crushed stone, and 241,858 cubic yards of sand. During the year, 945,525 barrels of cement were received into the storehouse, and in the same time an average of 6.08 of the eight 2-yard mixers furnished a total of 602,851 cubic yards of concrete. The total amount of masonry laid by the construction plant and by hand at the Gatun locks aggregated 911,137 cubic yards—a rate of 260.6 cubic yards per hour of service. The cost of the masonry was $6.64 per cubic yard. At the close of the year the masonry for the Gatun locks was 68.84 per cent completed. Over half a million cubic yards of backfilling was placed in the rear of the side walls of all the locks. A total of 31,060 feet of concrete piling was constructed for the foundation of the south middle approach wall, leading to the locks from Gatun Lake.

A total amount of 864,033 cubic yards of stone was crushed at the Porto Bello quarry at an average cost of 1.38 cents per yard, and from Nombre de Dios a total amount of 441,919 cubic yards of sand was obtained and transported in barges to Gatun, where it was transferred to the stock pile, at a cost, in the stock piles, of 1.86 cents per cubic yard.

Gatun Dam.

The Gatun dam has been formed by building two large rock embankments, and filling in the intervening space by hydraulic sluicing. During the year, on the east portion of the dam, the embankments have been raised from 65 feet to 85 feet above mean tide, and the hydraulic fill has been raised from 51 to 73 feet. On the west portion of the dam, the dry fill has been raised from 35 to 67 feet, and the hydraulic fill from 16 to 57.3 feet. The total increase of material, dry and wet, during the year has been 5,819,056 cubic yards. The cost of this work has been 38 cents for dry fill, and 23 cents for wet fill. The material for dry fill was brought by railway from Culebra cut, from the lock site, from Mindi, and from the spillway. The hydraulic fill was obtained from above and below the dam, and was placed by five suction dredges. The dam at the close of the fiscal year was 74 per cent completed.

Work on the spillway has proceeded very satisfactorily, and the concrete portion of the work is 66 per cent completed.

The channel between Gatun locks and the Atlantic is being attacked at several points, and 423,427 cubic yards have been removed between the locks and the Mindi hills. From the excavation through the Mindi hills 401,511 cubic yards have been removed by hydraulic dredge, and 280,000 cubic yards of earth and rock have been taken out by steam shovel. Between the Mindi hills and deep water in the Caribbean, the sea-going dredge "Caribbean," two dipper dredges, and three French ladder dredges have removed 4,516,369 cubic yards of earth and 487,038 cubic yards of rock, at a cost of 22 cents per cubic yard. The breakwater leading out from Toro Point has been pushed forward until, at the close of the year, 5,365 feet of double-track trestle had been completed, and 359,800 cubic yards of fill had been dumped from the trestle.

Central Division—Culebra Cut.

In the central division, the most important construction district is, of course, the great Culebra cut, from which during the fiscal year over sixteen million cubic yards were excavated, leaving, according to estimates of July 1st, 1911, about twenty-four million cubic yards yet to be taken out. The amount remaining has been increased during the year by 4,076,000 cubic yards, this to allow for the enormous slides which have developed, in the removal of which alone during the year, 4,880,000 cubic yards has had to be handled, which is over 30 per cent of the total amount removed from the cut during the year. The magnitude of this problem may be judged from the fact that thus far 10,757,000 cubic yards have been removed from slides, and the estimated amount remaining is nearly six million cubic yards. Col. Goethals states that slides follow the excavation in places where the material is left at a steeper slope than it will assume in its natural state; in which case it sloughs off until the natural slope is reached, and the movement ceases. Experience shows that it is only a question of time when these slides will cease entirely. Six of the good-sized slides are now quiet, and there is less trouble generally from this cause than at any time since the slides began to move.

A gratifying feature of this problem is the fact that, in spite of the enormous increase of 15,000,000 cubic yards of excavation due to slides, the reduction in unit cost, due to the splendid efficiency of the organization, will wipe out the extra cost of the slides, leaving the original estimate of excavating Culebra sufficient to cover the total cost of the work.

The average cost for excavation for the year was 59 cents per cubic yard, and at the close of the year the Culebra cut was 73.75 per cent completed.

Pacific Division.

The work of this division consists of the construction of the locks and dams at Pedro Miguel and at Miraflores, and the excavating of a channel between the locks, and from Miraflores locks to deep water in the Pacific. The total amount of concrete laid in the Pedro Miguel locks at the close of the year was 665,056 cubic yards, and the lock was 79.43 per cent completed. The locks at Miraflores, so far as the concrete work is concerned, are 19.27 per cent completed. As regards the channel between the locks and the Pacific Ocean, work has advanced satisfactorily between the two locks, and operations are being vigorously pushed upon the section lying between Miraflores locks and the Pacific Ocean. The dredges operating in the channel during the year were the 20-inch suction sea-going dredge Culebra, one dipper dredge, and three French ladder dredges. They removed from the channel a total of five and a half million cubic yards at a cost of 25 cents per yard, leaving a total of 4,700,000 cubic yards to be removed, including an estimate for slitage.

Towing Locomotives for the Gatun Locks.

By studying our front page engraving, it is possible to get a very accurate impression of the Gatun dam, with its spillway through the center, and of the massive concrete locks, through which access will be had to the Gatun Lake. The Gatun locks will be double, one set for ascending and the other for descending vessels. They will be in three flights, and will have a total lift of 85 feet—this being the difference between the level of the surface of the lake and mean tide level of the Atlantic at this point. The locks lie some six miles from the Atlantic shore line, and the channel will be tidal up to the lower lock gates, with a small rise and fall of two feet—one above and one below mean level. (At the Pacific end, the rise and fall is 11 feet above and 11 feet below mean tide level.) The locks are the largest ever constructed, each having a width of 110 feet and a usable length of 1,000 feet. Entering the canal from the lake ships will find themselves guarded against running into the locks by fender chains which normally will lie at the bottom of the locks, but when a ship is entering will be stretched across the surface. As a further protection to the gates, there will be guard gates, placed some distance ahead of the main gates. These gates could be wrecked by an over-running ship without destroying the integrity of the canal and letting the water out of the lake.

Should a big vessel, becoming unmanageable enter with such force as to carry away fender chain, guard gates, and the main gates themselves, an emergency dam is provided, by which the entrance to the locks could be closed. This dam consists of a massive swing bridge, which, in case of accident, could be turned so as to lie across the lock entrance. From the over-spanning bridge a series of massive leaves of plate steel, extending entirely across the lock prism would be lowered, gradually shutting off the flow of water, from below upward until the wall of plates extended above lake level, when the entrance would be entirely closed.

Ships will not pass through the locks under their own power. Each ship will be taken in hand by four powerful electric locomotives, one off each bow, and one off each quarter. The locomotives will each weigh 70,000 pounds. They will be driven by electric motors, operating gears which will engage a rack rail, and the hawsers from the ship will be attached to the wind lasses of the locomotives, which will be provided with friction clutches, that will prevent the drums sustaining a pull of more than 25,000 pounds. The speed of the ships, when in tow of the locomotives will be not over two miles per hour. The provision of rack rail traction, and the power and number of the locomotives, combined with careful operation, will practically eliminate any risks to the locks during the passage of vessels.

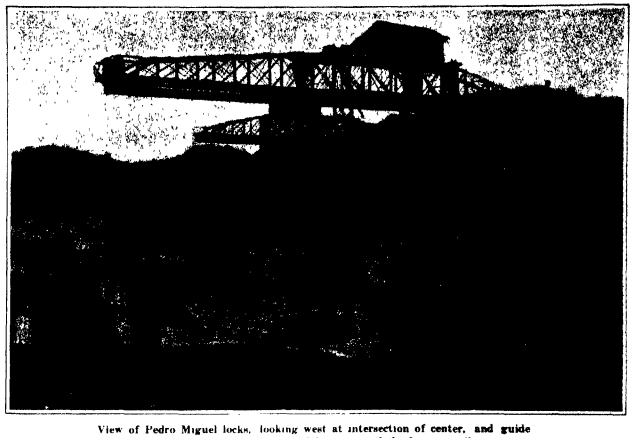
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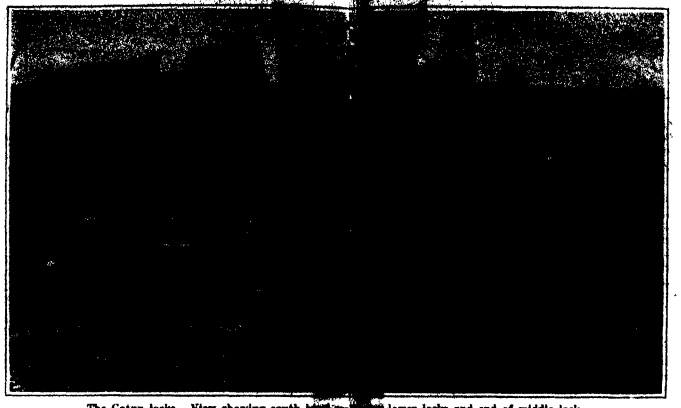
To Our Subscribers

WE are at the close of another year—the sixty-seventh of the SCIENTIFIC AMERICAN'S life. Since the subscription of many a subscriber expires, it will not be amiss to call attention to the fact that the sending of the paper will be discontinued if the subscription be not renewed. In order to avoid any interruption in the receipt of the paper subscriptions should be renewed before the publication of the first issue of the new year.

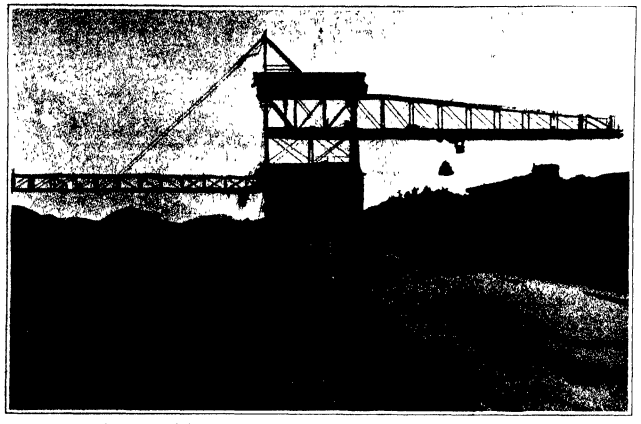
To those who are not familiar with the SCIENTIFIC AMERICAN SUPPLEMENT a word may not be out of place. The SCIENTIFIC AMERICAN SUPPLEMENT contains articles too long for insertion in the SCIENTIFIC AMERICAN, as well as translations from foreign periodicals the information contained in which would otherwise be inaccessible. By taking the SCIENTIFIC AMERICAN and SUPPLEMENT the subscriber receives the benefit of a reduction in the subscription price.



View of Pedro Miguel locks, looking west at intersection of center, and guide walls. The concrete walls are erected by means of the large cantilever crane.



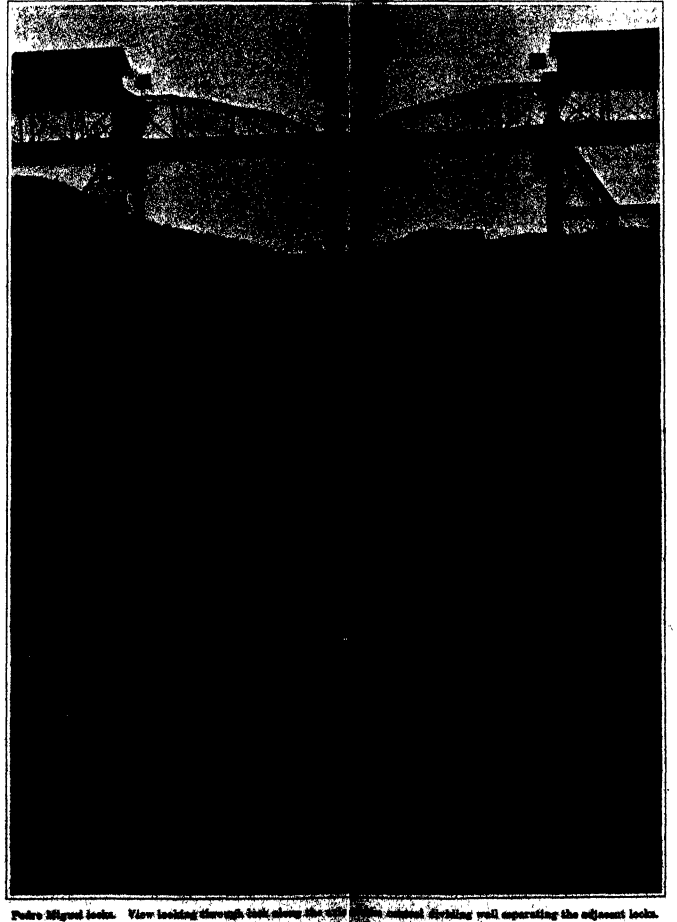
The Gatun locks. View showing south [illegible] lower locks and end of middle lock.



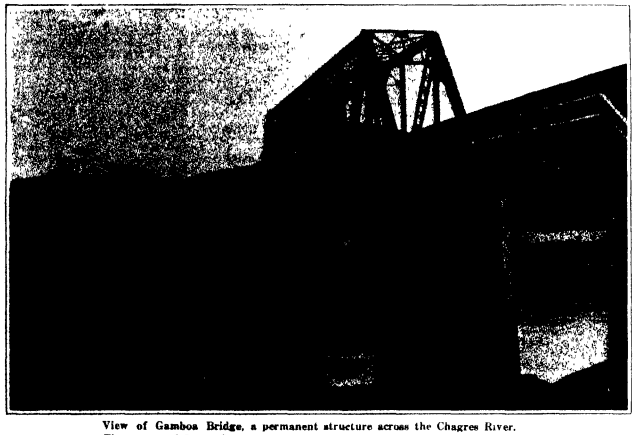
A view of one of the cranes at Miraflores. These are used for conveying the stone, sand, etc., from the stock piles to the mixers located in the base of the towers



Looking north at the upper chamber of the east lock at Gatun. The bridge across the lock in the foreground is being used in connection with the erection of the gates of the lock.



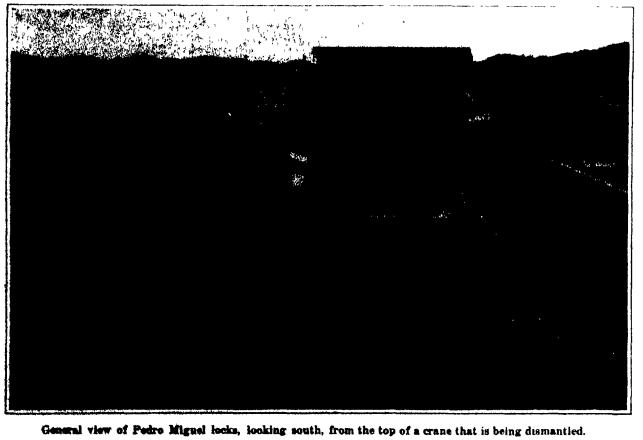
Pedro Miguel locks. View looking through [illegible] original dividing wall separating the adjacent locks.



View of Gamboa Bridge, a permanent structure across the Chagres River. The waters of Gatun Lake will back up to about ten feet below this bridge.



Bird's eye view of one of the guide walls, looking south, taken from top of a chamber crane.



General view of Pedro Miguel locks, looking south, from the top of a crane that is being dismantled.

RECENT VIEWS OF [illegible] AT PANAMA

Photographs copyrighted [illegible] Underwood & Underwood

The Inventor's Department

Simple Patent Law; Patent Office News; Inventions New and Interesting

A Typewriter for the Blind

IN view of the highly developed sense of touch in blind persons, the idea naturally suggests itself to construct a typewriter especially for their use, with the keys marked with the characters in raised type. A machine of this character, shown in the accompanying illustration, is the invention of M. Cayzergues, of Paris Needless to say, when the operator has



A typewriter for the blind.

become proficient, the marks upon the keys are no longer necessary, and in fact the provision of raised characters upon the keys is the least of the special features required in a machine for the blind What is needed is some arrangement whereby the operator is able to check up his work as he goes along and to correct any mistakes that may occur With this in view, the machine which has been built is a combination of two separate printing mechanisms, both operated simultaneously from the same keyboard One set of levers produces a record in raised characters on a paper cylinder, while another set at the back produces the usual written copy upon a separate sheet The copy thus obtained represents the ordinary letter form as employed for business and other purposes, while the record on the paper cylinder is made in the special character used by the blind, consisting of a combination of small dots In this way the blind writer is furnished on the one hand with a copy of his letter and on the other hand with a means for reading his writing as he goes along

The new typewriter is not very much more complicated than the usual form Each paper roller slides along a toothed rod, in such a way that every time a key is struck, both carriages move along the distance of one tooth The spacing of the lines is effected by hand by pushing a lever, so as to shift the roller carriages one space The front carriage is arranged to operate the rear carriage through a rod and gear coupling The raised record is so placed that the operator can run his fingers over it practically without interfering with his work

When desired, the special mechanism for the blind can be disconnected and either part of the machine used separately

Springless Truck for Rough Ground

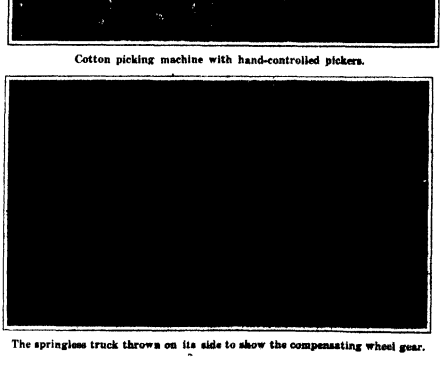
THE accompanying engraving illustrates a very novel form of vehicle, which by the use of eight wheels, dispenses with all springs, the wheels being so mounted as to enable it to travel over rough ground without being materially lifted by the obstacles over which it passes A closer examination of the engraving will reveal the construction Each wheel is mounted in a separate fork hinged to the frame above. The forks are connected in pairs by links running from crank arms on each to a common cross tree As a result, should one wheel strike an obstacle, it would swing backward to clear the construction and in so doing would draw the cross tree backward, pulling its mating wheel forward There would thus be a co-operative action between the two wheels in passing over the obstacle which would result in a practically level running of the vehicle body Such being the case, there would be no necessity for springs. Of course, the truck body would not run perfectly level, but the rise and fall would be considerably less than with a four-wheeled truck of the ordinary construction As most of the work done in drawing a vehicle consists in raising it over obstructions, it follows that the flexible wheel mounting here shown would call for much less tractive effort than is ordinarily the case.

Novel Cotton-picking Machine

THE machine which is pictured in the accompanying engraving is not completely automatic in its action It is provided with a number of pickers, each of which must be separately controlled by an operator The machine is driven by a three-horse-power kerosene engine, the entire outfit weighing about 800 pounds The pickers operate somewhat on the principle of the spiral screw-driver They consist of a shaft which rotates and at the same time has a reciprocal motion, so that it will alternately protrude and withdraw into a casing The latter movement is produced by means of a guide with a double spiral groove At the end of the shaft is a finger adapted to catch the cotton boll and twist it out of its pod, after which the picker is withdrawn within its casing, the boll is stripped from the finger and carried by means of an air blast through a cleaner that removes any leaves or sticks that may adhere thereto, and deposits the clean cotton in a bag The picking finger is operated by means of a flexible shaft, while a separate flexible tube runs to the picker to convey the cotton to the cleaner By providing individual control of the pickers, the cotton may be picked from parts of the plant which might be inaccessible to a purely mechanical machine On a test with the cotton picker illustrated, two men being employed, a hundred pounds of cotton was picked per hour.



Cotton picking machine with hand-controlled pickers.



The springless truck thrown on its side to show the compensating wheel gear.

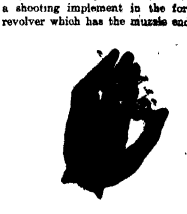
Youngest Patentee of Record

THERE is no age limit to patentees. Take the patent, No. 465,066, of December 15th, 1891, to Donald M. Murphy, of St. John, Canada. One might think from his X mark signature to the specification that Donald could not write his name, and he could not, for he had no book learning, but he did have the inventive ability to produce a sounding toy for which the United States Patent Office granted him a patent But do not blame him for his lack of schooling, for Donald was only six years old when he filed the application, and as far as is known the youngest applicant for patent in this or any other country His picture formed a part of the Patent Office Exhibit at the Chicago Worlds' Fair in 1893 The toy patented to him is a simple contrivance including a bar with handle knobs at its ends and two clapper disks slidable along the bar so they can sound against each other and against the handle knobs. See accompanying illustration

Notes for Inventors

Death of Thomas Hall.—Thomas Hall, known for his inventions in connection with the manufacture of typewriters, died recently at the age of 77 He won a prize at the Paris Exposition of 1867, by the exhibition of a keyed typewriter Mr Hall also invented a number of sewing machine attachments and an improved drill grinder. He was born in Philadelphia, February 4th, 1834

Fire Arm for Stage Use.—Most of us cannot shoot straight with a revolver designed for straight shooting, but to make sure of this John E. Basmer, of Mt. Airy, N. C., has patented (No. 1,007,174) a shooting implement in the form of a revolver which has the muzzle end of the





Clapper invented by a six-year-old boy.

barrel closed and its bullet passage or bore deflected at its discharge upwardly and out through the top of the barrel so the bullet will pass almost vertically upward.

A Cloud Protector for Aeroplanes.—Army and navy ordnance experts are giving much time and thought to the best manner of attacking airships aloft Various guns for firing at the fliers have been invented "Is it not practicable," says one of our correspondents, "to provide some means, chemical or otherwise, by which the aviator can, at his pleasure, produce some cloud like vapor to envelope his machine and obscure it from the view of the enemy? The artificial cloud might be visible, but would only form a large target while the machine, the real objective point of the firing lines, would form only a small part of the target, decreasing in proportion to the size of the cloud the prospect of being struck by the projectiles."

Color Changing Flaming Arc Lamp.—Color effects in arc lamps are sought by a patent, No 1,007,869, to Chas. W. Hill, of Lakewood, Ohio, assignor to National Carbon Company, of Cleveland, who provides an electrode for flaming arc lamps, in different portions of which are incorporated different substances, adapted as they volatilize, to give to the arc stream a characteristic color, thus imparting a succession of color changes to the arc as the electrode is consumed

Prevents Hen from Setting.—Setting hens are proverbially persistent but Vern M. Osborn, of Los Angeles, in patent, No. 1,008,050, furnishes a poke like device which he straps on the hen showing setting proclivities, the device being provided with a pair of legs which project down in front of the hen's legs so that she cannot assume her usual posture on the eggs.

A Hewitt Vapor Converter.—Peter Cooper Hewitt of Ringwood Manor, N. J., has secured a patent, No. 1,007,694, for a vapor rectifier in which a container has a conducting receptacle with hollow arms extending from it and conducting caps, constituting the terminals of the arms and forming the main positive electrodes of the apparatus, while the negative electrode is contained in the receptacle.

A Multi-blade Safety Razor.—A razor described in patent No. 1,007,847, granted to Axel Anselin Carlson, of Lindsborg, Kansas, has a casing and a blade guard. A carrier having a number of blades is revolubly mounted in the casing so that any one of the blades which are removably and yieldingly mounted in the casing may be brought into operative position relatively to the guard.

RECENTLY PATENTED INVENTIONS.

These columns are open to all patentees. The items are inserted by special arrangement with the inventors. Terms on application to the Advertising Department of the SCIENTIFIC AMERICAN.

Pertaining to Apparel.

DRYING AND STRETCHING FRAME.—C. WIRKLER, 1640 Amsterdam Ave., New York, N. Y. This invention relates to apparel apparatus. It provides a frame more especially designed for drying stockings quickly and in pairs to prevent misplacing of mated stockings and to prevent the stockings from shrinking, the frame also permitting of convenient adjustment to readily accommodate stockings of different sizes

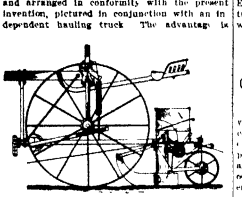
EAR MUFF.—W. H. FRENCH, Evansville, Ind. An object of this invention is to provide a strong and simple ear muff which serves efficiently to cover and protect the ear against the injurious effects of cold, wet, wind, etc., which is compact in form, and which is so constructed that it can be securely held in place without the use of a spring bow or other devices

ELECTRIC TIME SWITCH.—C. J. LINDEWALD, 312 Dean Building, South Bend, Ind. An object here is to provide a device which is controlled by clock-work, and which may be set to close a circuit at any predetermined time, and to open the same subsequently at any predetermined time. A further object is to provide a device in the nature of an improvement to an ordinary clock for accomplishing the closing and opening of the switch.

Of Interest to Farmers.

COW STANCHION.—F. A. BRUNDAGE, Box 38, Belmont, N. Y. This invention relates generally to cow stanchions, and more particularly it involves an improved form of stanchion having means whereby the movable bar in the stanchion may be locked and unlocked. The stanchion has an improved locking means whereby the movable bar may be easily and quickly brought to either operative or inoperative position

AUXILIARY PLANTER.—A. R. BALDWIN, care of Rogers and Baldwin Hardware Co., Springfield, Mo. The accompanying illustration shows a side view of a planter constructed and arranged in conformity with the present invention, pictured in conjunction with an independent hauling truck. The advantage is

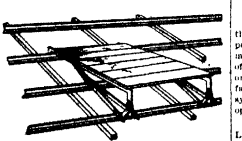


AUXILIARY PLANTER

obvious, as it enables the planter to be used in conjunction with any other suitable farm implement. As an instance, it will be conceived that to attach a planter thus constructed to follow gang plows or harrows would serve to shorten the operation of preparing the field by just so much time, cost and labor as would be needed to plant the field after the bed has been prepared, as in the present custom

Of General Interest.

ADJUSTABLE BRACKET.—P. WHITE, 102 Academy Street, Long Island City, N. Y. This invention relates to a form of bracket for scaffolding, more particularly adapted for use by the setters on sloping constructions. The objects of the inventor are obtained by constructing a bracket of a general triangular shape, having an adjustable hook depending



ADJUSTABLE BRACKET.

from one end to fit over a metallic framework of an unfinished roof, positioning two of these brackets apart on the roof and connecting the same by a seanting of lengths of boards to form a readily constructed bracket. The perspective view herewith shows an embodiment of the invention applied to a roof construction

COMB AND BRUSH.—W. J. HOPE, Tunica, Miss. This invention is an improvement in a comb and brush, and the aim is the provision of a simple, compact and cheaply constructed device combining the functions of both instruments, as shown in the engraving, which will be capable of being carried in the pocket, will not easily collect dirt, and which may be easily cleaned. It is handled in the same manner as an ordinary comb. As the teeth pass through the hair, the bristles smooth the hair



COMB AND BRUSH

both in front and behind the teeth. Either set of bristles may be used alone by inclining the comb, or the teeth may be used with both. Only a slight portion of the length of the teeth extends below the bristles

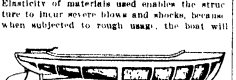
GUITAR.—A. BRATTO, 1261 Lyod Avenue, High Bridge, Bronx, N. Y. The invention relates generally to stringed musical instruments and more particularly it involves an improved construction of body of a guitar. From the engraving it will be seen that the bridge is supported entirely by the sounding board being out of contact with the top of the body,



GUITAR

this construction affording an increase in volume and an improvement in the tone of the sounds since the free vibration of the board is not interfered with in any way by the hands when playing, the vibration of the strings is transmitted directly to the sounding board and none of the energy of vibration is dissipated in through contact with the body since the bridge rests on the sounding board

UNSINKABLE BOAT.—J. PANTOREL, P. O. Box, 947 Asbury Park, N. J. The frame is constructed of hard rubber and is covered with sheets of rubber or rubber cloth in such a way as to form independent air tight compartments, inflated to increase the boat's buoyancy. Elasticity of materials used enables the structure to incur severe blows and shocks, because when subjected to rough usage, the boat will

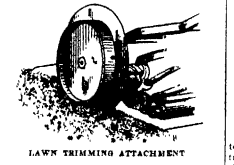


UNSINKABLE BOAT

yield instead of breaking as it might in case common material, such as wood or iron, were employed. The object of the inventor is to produce a vessel which will be lighter, faster and better able to resist damage than any other vessels of the same description. The engraving shows a side view of the framework

Hardware and Tools.

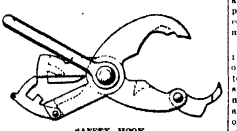
LAWN TRIMMING ATTACHMENT.—W. F. HILL, Charleston, Ill. It is the purpose in this invention to provide a lawn trimming or edging attachment of novel form and design which may be detachably secured to a wheel of an ordinary lawn mower, as pictured in



LAWN TRIMMING ATTACHMENT

the accompanying engraving, and when in position may be efficiently operated, with a minimum of time and labor required, to cut off all grass projecting outward over the edge or border of a grass plot, and to trim the face of the turf or sod in a uniform and symmetrical manner. The device may be operated by an unskilled operator.

SAFETY HOOK.—R. LANGE, care of Hugo Lange, Okanogan, Wash. This device is adapted



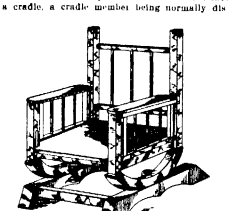
SAFETY HOOK

to carry a load of crates, or used as a harness hook or other readily-releasable connecting device suitable for carrying a load or resisting a strain. To this end the hook in general comprises two hook members pivoted together to swing to and from each other, one of the hook members having a gate adapted, when the hook members are closed and locked, to swing inwardly and permit the insertion and removal of the suspension link, the gate arranged at the mouth of the hook to take the strain on the link. The illustration shows the hook members released and swung apart

Household Utilities.

BROILER.—J. W. TAYLOR, Box 93, Antigonishe, Nova Scotia, Canada. In this patent the invention has reference generally to broilers and more particularly it relates to those articles of this class which comprise a pair of extended body portions suitably hinged together and between which articles of food are held over the fire in order to be cooked and held in a manner that will not permit the food falling out

CONVERTIBLE CHAIR.—A. DEMERS, 461 Granite Street, Manchester, N. H. This invention has reference to convertible chairs and it has for its purpose the provision of a rocking chair which may be readily converted into a cradle, a cradle member being normally dis-



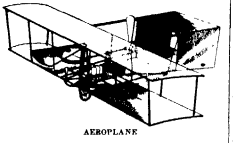
CONVERTIBLE CHAIR

posed under the seat of the chair which may be erected across the front of the chair to form the side member for the cradle, the sides of the chair being adjustably mounted so that they may be lowered to a horizontal position to form the head and the foot of the cradle. The chair is pictured in perspective in the accompanying illustration

Machines and Mechanical Devices.

CHECK PROTECTOR.—C. H. SAMPSON, Rochester, N. Y. This invention refers to protectors employed for providing a check with a mark pressed into the paper and representing a certain sum and the words "Not over." It provides a protector arranged to permit the user to view the line of the check where the printing is to take place and to provide a single hand lever mechanism for controlling the movement of the printing parts

AEROPLANE.—G. W. THOMPSON, Kingston, Okla. This invention relates to flying machines of the heavier than air type and the object is to provide a machine of this class which has its propellers so arranged that they not only drive the machine but steer it also. By such a construction the inventor minimizes the necessity of using movable rudders here-



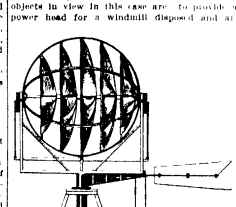
AEROPLANE

tofore used to control the machine's course of travel. Balancing is accomplished by locating the power plant directly below the center of gravity of the supporting planes, and by the manner in which the planes are tilted with reference to the line of travel. The improved aeroplane is shown in perspective in the accompanying view

FLYING MACHINE.—R. COLE, Norwalk, Ohio. This improvement relates to a flying machine, and particularly to aeroplanes in which an automatic balance of the equilibrium is obtained. A further object is to provide a flexible connection between the main supporting plane and the frame, whereby the equilibrium of the aeroplane is automatically maintained

FLUID PRESSURE TOOL.—A. C. MCFARLANE, 601 North Wabasch, Colo. The object of this invention is to provide a fluid pressure tool, arranged for running the tool at a high speed and with economy in the use of the motive agent, to reduce jar and vibration to a minimum and to prevent breaking of the operating parts, especially when the tool is running without the drill being in place.

WINDMILL.—C. F. CRADDICK, 514 W. Porphyry St., Butte, Mont. The accompanying engraving shows a side elevation of a windmill constructed and arranged in accordance with the present invention. The principle objects in view in this case are: to provide a power head for a windmill disposed and arranged as a series of turbine shape rotating members, provides a power head having a maximum wind pressure surface disposed in power relation to the wind and having the maximum of exposed surface when disposed in angular relation to the wind and to provide regulating means for automatically varying the pressure under operative conditions



WINDMILL

Prime Movers and Their Accessories.

ELASTIC FLUID TURBINE.—R. HARRISON, 58 Chancery Lane, London, England. In this patent the invention has for its purpose the production of an efficient turbine of simple and strong construction having the steam nozzles, exhaust openings and connecting channels so arranged that the work to be done by the steam shall be distributed over two or more stages arranged around the circumference of a single rotor

CARBURETER.—W. A. HARRIS, 237 John St., Greenville, S. C. The invention in this case is an improvement in carburetors and the purpose of the inventor is the production of a carburetor of the character specified for use in vaporizing gasoline and mixing air therewith in the most favorable proportions for the most efficient combustion

Railways and Their Accessories.

RAILROAD TIE SPACER.—J. W. WOOD, Nicolas, Cal. In the present patent the invention is a spacer for railroad ties, and it comprises a device which can be readily placed in position to grip the top of a rail and which acts as a fulcrum for the spacing bar which is used to force the tie into proper position

BRAKE BEAM AND FULCRUM THEREFOR.—J. B. SIMPSON, Paxton, Pa. This improvement relates to brake beams and fulcrums therefor, and it has for its object to provide a fulcrum member having means by which it may be conveniently secured to a U-shaped or other beam without slipping, the fulcrum over the end of the beam and without splitting the fulcrum member

Pertaining to Recreation.

TRAVELING ROCKING HORSE.—W. ROGERS, 762 W. Mulberry St., Springfield, Ohio. This improvement has reference to traveling rocking horses and the object is to provide one which is propelled by means connected to a rock shaft to which the horse is secured, stimulating means provided which, in connection with steering mechanism by which the direction of travel may be controlled

Pertaining to Vehicles.

VEHICLE TIRE.—F. TAUMAN, Morley, Iowa. The invention provides a resilient tire constructed of spring metal to avoid disadvantages in the employment of rubber tires of usual construction, provides a tire constructed from a series of sectional forms each detachable and replaceable, provides an articulated tire of metallic sectional springs each cooperatively connected with adjacent springs to unite the action of the springs, provides a tire with stop members to reinforce the tire structure to avoid the breakage of single sectional springs when subjected to sudden strains, and provides for a tire a wearing shoe constructed from a series of assembled short removable sections

Designs.

DESIGN FOR CARPET OR RUG.—J. S. BROWN, care of G. S. Squire, Hartford Carpet Corp., 41 Union Square, New York, N. Y. This design for a carpet or rug is oblong in form and exquisitely ornamental in composition. Inside and near the edge there is an elaborate border of figures in a white ground and a mass of small dotted circles separates this border from a bright centerpiece in a white field. Mr. Brown has patterned another carpet or rug design of the same shape with a rather dark and brilliant mixed border, separated from the centerpiece by a scrolled work runner in a white field. The centerpiece is elaborate and abounding in arrangements of flowers.

NOTE.—Copies of any of these patents will be furnished by the SCIENTIFIC AMERICAN for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper

Retrospect of the Year 1911

(Concluded from page 601.)

plane On January 30th, McCurdy attempted to fly from Key West to Havana. After covering ninety miles out of the one hundred in two hours, he fell in the sea, owing to a burned-out bearing on his motor Mr Glenn Curtiss first succeeded in rising from the water, with his biplane equipped with floats, at San Diego, on January 26th Thus was born America's first hydro-aeroplane Curtiss constructed a number of these machines, several of which have been supplied to our navy and one to that of Russia which is very active in aviation Using one of them, Hugh Robinson flew several hundred miles down the Mississippi from Minneapolis, carrying mail, which he left at the towns on route The mail-carrying experiments made on a larger scale at the aviation meet at Nassau Boulevard, together with Robinson's demonstration convinced Postmaster-General Hitchcock that the aeroplane can be used successfully for delivering mail to inaccessible places Many exhibition flights have been made in America this year, the most daring and thrilling of all having been Lincoln Beachy's clip over Niagara Falls and flight through the gorge which he made with a headless Curtiss biplane

The chief development in aviation this year has been the change from the exhibition flight to the long-distance, cross country race or tour A half dozen big races such as the Paris-Madrid, Paris-Rome, European Circuit, Circuit of Britain etc, were flown successfully abroad and were practically all won by monoplanes which appeared to be faster and safer than the biplanes In America, however, Beachy and Ely gave some marvelous exhibitions of flying in strong winds with the latter type of machine A Maurice Farman biplane on March 7th, made the 225 mile flight from Paris to the Puydc-Dome Mountain, without a stop, and carrying two men. Eugene Renaux, the pilot thus won the Michelin $20,000 prize which had been offered exactly three years before Vedrines on a Morane monoplane, won the Paris-Madrid race and secured second place in the 1,060 mile Circuit of Britain This English event, as well as the Paris-Rome and the European circuit was won by Lieut Conneau of the French navy, while Roland Garros was second in the two latter races Both of these aviators used Blériot monoplanes The Paris-Madrid race of 900 miles was covered in four days and the Circuit of Britain required but three days' flying by Conneau and Vedrines The two other machines which finished required fifteen and fourteen days respectively M Garros on September 4th, made a new height record of 4,272 meters (13,950 feet), thus beating by 2,370 feet the record of Beachy at Chicago, and climbing some 750 feet more than 2½ miles above the earth's surface

Last summer Harry N Atwood flew from Boston to Washington with his Wright biplane, carrying a passenger most of the way Later he flew from St Louis to New York by way of Chicago, in fourteen days Enthusiasm over his success Calbraith P Rodgers and Robert G Fowler started to fly across the continent from New York and San Francisco respectively Both aviators used Wright biplanes and were accompanied by special trains carrying spare parts After three unsuccessful attempts at climbing over the Sierra Nevada Mountains, Fowler finally flew to the southern route, which was the one chosen by Rodgers Rodgers left Sheepshead Bay on September 17th His route was to Chicago, St Louis, San Antonio, and El Paso, Texas, from which State he followed the Southern Pacific Railroad He finally reached Pasadena on November 5th In flying the 25 miles from there to the Pacific Ocean, he sustained a bad fall and was laid up several weeks Finally, on December 10th, he finished the first trans-continental aeroplane flight He passed Fowler at Tucson Ariz and the latter has now progressed almost as far as New Orleans.

Orville Wright conducted some experiments with a 145-pound glider at Kitty Hawk, N. C., late in October These experiments were of great interest from the fact that Mr Wright succeeded in rising in the teeth of a 50-mile gale and remaining aloft once for 7¼ minutes, and again for 9¾ minutes. In the shorter flight, he hovered for five minutes above a given spot. Mr Wright obtained valuable information relative to the designing of a machine with flattened surfaces, capable of flying in the strongest winds.

To the death list of flyers, numbering this year 76 should be added the loss of Octave Chanute, who was known as America's "Father of Aviation," and also that other pioneer, Prof. John J. Montgomery of Santa Clara College, Cal. The latter was killed while experimenting with a new glider A large number of the fatal accidents were due to recklessness and foolhardiness in making exhibition flights, but there have also been accidents from breakages of machines The causes of the various accidents have not all been determined, but the proportion of deaths to the number of miles flown is without doubt less than in 1910 The carrying of as many as six passengers on cross-country flights of one hour, and the development of an aerial taxicab, which has flown successfully, has put heart into those who believe the aeroplane has a future as a means of public rapid transit It will also undoubtedly be used for the regular carrying of mail in the near future The severe tests for French military aeroplanes resulted in seven machines making a flight of 186 miles without a stop, when carrying two men and 660 pounds of dead weight The winner was a Nieuport monoplane, piloted by Weymann, the American aviator, who also won the International Cup race for this country with the same make of machine on July 1st last He made an average speed of 72 miles an hour in the military contest with a 70-horse-power monoplane, whereas in the international race, he made 78.1 miles with a 100-horse-power motor

The development of the dirigible balloon has resulted, in Germany in a passenger-carrying rigid airship, the "Schwaben," which has made numerous sight-seeing trips about the Fatherland, running on schedule, with a regularity which has strengthened the belief in the commercial and military future of the dirigible The "Schwaben" developed a speed of practically 43 miles an hour, with 150 horse-power when accurately tested over a measured course In France, the non-rigid dirigible has been developed to a point of gratifying efficiency, and the government is building additional Lebaudys for the use of the army. For scouting, the aeroplane is simpler and, in many ways, superior to the clumsy airship At Tripoli recently, Italian aeroplanes are reported to have dropped bombs upon the Turkish troops with disastrous effect The huge English dirigible, the "Mayfly" broke in two when being drawn out of its shed, and as a consequence opinion in Great Britain is more favorable to the aeroplane Two airships, the 'Suchard' and the "Akron," were constructed this year in Germany and America for the purpose of crossing the Atlantic. The former is to start from the island of Teneriffe, and the latter from Atlantic City Neither was completed in time to attempt a flight this year, but it is probable that next spring both will start In this great attempt Mr Vaulman, after his experience with the "America" in 1910 has constructed a new and larger airship from which he believes he has eliminated the troubles which led to his previous failure

A Dark Substance in Space

IN the vicinity of the star S Coronæ Australis Innes and Worsell have found a patch of sky 25 minutes of arc in diameter where no star can be seen with a 9-inch refracting telescope According to Innes, who discusses the subject in "Transvaal Observatory Circular No 5," the apparent absence of stars in this region is due to the occurrence of some absorbing medium, interposed between us and distant parts of the universe Stars in the neighborhood of the dark region are enveloped in nebulæ; while just on the border of it there is a star which has been observed to fluctuate in magnitude between 11.0 and 12.2, and which was invisible during the years 1896-1901. The latter fact is accounted for on the supposition that the absorbing medium was for a time in front of the star, but has since withdrawn from it.

The Most Remarkable Testing Laboratory in the World

(Concluded from page 596.)

to decide whether or not a certain lubricant had spoiled a suit of clothes. The judge washed his hands of the matter and submitted the lubricant to the Royal Laboratory for Testing Materials. With characteristic thoroughness the Laboratory experimented with stains which were produced by the lubricant. First, it determined whether the stains could be eradicated by washing or only with the aid of special solvents, or not at all. Then it determined whether the color of the cloth had suffered as the result of attempting to remove the stains. Finally, it ascertained whether the strength of the cloth fiber had been impaired by the process of cleaning It reported to the court that stains made with the lubricant on cotton, wool and linen could be easily removed, that the lubricant had no injurious effect on the dyes employed, and that the lubricant did not weaken the fiber, even after prolonged intimate contact—in a word, that the cloth was not irretrievably spoiled

Settling Patent Infringement Suits.

In patent infringement suits, as might be expected, the Laboratory does yeoman service for the court It does not construe claims, for that is a matter of law; but it determines matters of technical fact, with the result that a judge is spared the necessity of considering a mass of technical data. To a layman in science, even though he be a lawyer, must seem a hopeless jumble of cryptic phrases One such case turned upon the point whether or not a certain brand of soap was so greatly superior to another in washing qualities as to be patentably different On behalf of the court, the Laboratory made a study of the two soaps to determine their solubility in water, acids and lime solutions, and their effect on dyes and on fabrics. It showed conclusively that the one soap was no better than the other

These opinions of the Laboratory on matters of technical fact are by law made binding upon the courts A judge must accept the technical decision of the Laboratory and rule accordingly

Germany has a tariff, which, like our own, is intended to protect the home producer Disputes with the customs authorities are therefore as frequent in Germany as in the United States. The American appraiser submits imported goods for scientific examination either to chemists or physicists in the employ of the customs service, or else he employs outside experts The German customs authorities call upon the Royal Laboratory for Testing Materials for assistance. In a controversy which arose between the customs authorities and an importer of mercerized cotton, the government maintained that the fabric was dyed and therefore subject to a higher duty than if it were undyed The importer insisted that the cotton was undyed Gross Lichterfelde examined the fabric scientifically and supported him in his contention.

An American Appeals for Scientific Help.

Foreigners, too, resort occasionally to the Laboratory when the questions at issue affect German industry. I was told of an American importer of German paper who had been compelled, as he thought, to pay a higher duty in the United States than the Dingley tariff required. Because the importation was an oily German paper substitute for parchment, he asked the Laboratory to tell him how treated papers could be scientifically distinguished from untreated papers. He received an exhaustive description of the turpentine oil test, armed with which he intended to appeal to the American customs authorities again. Another foreign firm wished to ascertain whether its steel hydrogen flasks met the requirements of the German police regulations governing the traffic in liquid and compressed gases. Flasks were sent to Gross Lichterfelde. There it was found that the wrong kind of metal had been employed, and that the police requirements had by no means been fulfilled.

Whenever any department of the German Imperial Government is confronted with a technical problem for solution it is

(Concluded on page 604.)

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The SCIENTIFIC AMERICAN *for* 1912

Magazine Numbers for 1912

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FEBRUARY 10—
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MARCH 16—
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APRIL 13—
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MAY 18—
Our Coast Defenses
JUNE 15—
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JULY 13—
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SEPTEMBER 14—
Aviation
OCTOBER 12—
Labor-Saving Machinery
NOVEMBER 9—
Invention
DECEMBER 7—
The Panama Canal

AT the close of last year, under the caption of The Greater "Scientific American," the publishers announced that the scope of the paper would be extended; that a series of mid-month numbers of greatly enlarged size, contained in a colored cover, would be issued, the contents being devoted to some special subject of national importance. We also announced that there would be a series of articles written by specialists in their several departments, and that these new features would be accompanied by a general improvement in the typography and make-up of the paper.

¶ The fifty-two issues of the past year speak for themselves; and their favorable reception by our subscribers and the general reading public encourages the publishers to continue the same policy, on even more progressive lines, throughout the year 1912.

Special Contributors

THE high quality of the Scientific American of 1911 will be evident from a study of its list of contributors, conspicuous among whom were President Taft, Secretary C. v. L. Meyer, Admiral A. T. Mahan, the chiefs of the various bureaus, and other high ranking officers of the navy; Secretary Charles Nagel, of the Bureau of Commerce and Labor; The Hon. John Barrett, Director of the Pan-American Union; Commissioner of Navigation E. T. Chamberlain, ex-Chief Forester Gifford Pinchot; Director F. H. Newell of the Reclamation Service; Judge Judson C. Clements, Chairman of the Interstate Commerce Commission; Dr. J. A. Holmes, Director of the Bureau of Mines; Professor Ira Remsen, President of Johns Hopkins University; W. J. Spillman, and other members of the staff of the Department of Agriculture; Robert Kennedy Duncan, S. A. Mitchell, H. N. Russell, H. W. Walker, Moyer S. Fleisher, E. L. Thorndike, T. C. Martin, and W. C. Brown, President of the New York Central Railway Company.

The list of contributors for 1912 will be equally distinguished. It will include the majority of the names above mentioned, together with others of high authority in the various fields that will be covered during the year. The Scientific American will continue to follow closely its avowed policy, as stated at the head of its Editorial Columns: "The purpose of this Journal is to record accurately, simply, and interestingly, the world's progress in scientific knowledge and industrial achievement."

The Broad Scope of the Paper

THE subjects dealt with in 1912 will come under the heads of civil, mechanical and electrical engineering; naval and military; the merchant marine; the internal combustion motor; chemistry with special attention to electro-chemistry and electro-metallurgy; science as applied to the industries; science in agriculture. There will be the usual amount of space devoted to biography, astronomy, scientific abstracts from current periodicals and archaeology. Under the subject of inventions, particular attention will be given to the leading inventions and to patent practice, with a reference to notable cases, and there will be the usual run of inventors' notes. The popular "Workshop" and "Laboratory" departments will make their regular appearance.

The Panama Canal Number

THE great popularity of our recent Naval Number, which was immediately recognized as a brochure on the navy of unusual authority and information, has decided the publishers to prepare a similar number in December, 1912, on the Panama Canal. The material for this issue will be gathered by our Editor-in-Chief, Mr. J. Bernard Walker, who will spend some time at Panama for the purpose of making a personal inspection of this stupendous work, and securing the necessary plans, photographs and data. The number will contain a complete account of the history, construction, operation, military defenses, and commercial and naval value to the United States of this great national undertaking.

Science in the Industries

AN important feature of the 1912 program will be a series of articles by Mr Waldemar Kaempffert, Managing Editor of the Scientific American, in which he will sketch the scientific basis of Germany's remarkable commercial success—the object of this series being to offer for the consideration of the American business man certain well-proved methods for increasing the physical efficiency of the workman and the amount and quality of his output. Two of the articles will deal with German education—"The German Commercial High School", which turns out captains of industry, and "The German Vocational School", which turns out soldiers of industry. The series will also include the following articles on the relation of science to industry: "The Royal Laboratory for Testing Materials at Gross Lichterfelde" (published in this issue), "The Utilization of Waste Materials", "The German Technological Museum at Munich" (the remarkable technological museum in which the visitor is allowed to manipulate, through a crank or other means, an operative apparatus), "The Workingman as a Human Machine", "The State and the German Laborer", "City Government as a Science", and lastly, "The Commercial Utilization of Scientific Discoveries"—a summing up of impressions gleaned from a dozen factories, workshops and cities. These articles will be based upon the facts and impressions gathered by the author during a recent extensive tour of Germany, made for this express purpose.

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almost sure to ask Gross Lichterfelde for advice. Thus, for the Royal Powder Works at Spandau, specifications were formulated for the manufacture of machine and cylinder oil, machine greases, linseed oil, turpentine oil and vegetable oils. For the Minister of Public Works a scientific test for distinguishing natural from artificial asphalt was worked out, and a study made of the thermal conductivity of refractory building materials. When the Imperial Printing Office decided to improve the quality of German post cards, Gross Lichterfelde made a study of existing cardboards and papers and practically invented a new composition which would answer modern commercial requirements. Hand in hand with the Artillery Testing Commission, tests were made with copper cylinders for measuring gas pressures. Even the German colonies consult the Laboratory, for the German governor in Togo and Kamerun submitted African woods for comparison with North and South American woods, with the result that in the near future Germany will probably draw upon her African supplies.

The institution at Gross Lichterfelde has a history that extends back to the experiments made by Dr. A. Woehler, an engineer who, in 1865, constructed the first really scientific testing apparatus employed in Germany. But the remarkable place which the institution has won in German industrial life and its world-wide reputation is due almost entirely to its present head, Geheimer Oberregierungsrat, Prof. A. Martens. When he was appointed to fill the director's chair in 1884 the entire scientific staff of the mechanical-technical department consisted of only three men, and the apparatus of two testing machines. What the development of the Laboratory has been since then may be judged from the highly varied character of the work here outlined. That astonishing development would hardly have been possible had not Maartens himself devised a very large part of the experimental apparatus which constitutes the equipment of the Koenigliches Material-Pruefungsamt.

Methods of Dust Extraction on Cotton-carding Engines

(Concluded from page 595.)

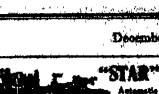
air trunk, this aperture is closed when stripping is not in operation at that machine. The draught is thus concentrated on one machine only. The aperture is automatically opened by the receiver itself as it reaches the machine to be stripped. The appliance is propelled by hand to any part desired by the workman. On arriving at a given machine, the funnel-receiver is brought immediately over the card-cylinder, close by the line where the dust is generated by the stripping-brush, and the indraught collects the dust before it can diffuse.

By a third method (Fig. 5) of dust extraction a vertical tube is provided over each carding-engine, this tube being connected with a casing or "hood," which is lowered to cover the stripping-brush when operating. A sliding shutter is fitted in the vertical tube. This is opened when ready for stripping, all other shutters being then closed. Thus the exhaust from the fan is concentrated on one "card" only. When stripping is completed the hood is raised in the vertical tube.

A fourth method (Fig. 6) has pipes depending from horizontal trunks following the lines of cards, but in each pipe is a patent valve, formed where the pipe can be flexed. When the pipe is vertical the interior is fully open; when flexed as far as possible, the aperture is closed. Hence in all tubes bent, so as to be out of the way of the workers, the valves are automatically closed. To operate this dust-extractor an aluminium cover is provided for each stripping-brush. The outlet pipe of the cover fits into the down-pipe just mentioned, so that when the fan is started the dust is drawn off as stripping proceeds. The power required for an average mill is estimated at about one horse-power.

The method now described (Fig 7) works on a portable principle. The stripping-brush is inclosed in a hood which has a flexible-tube connection with the dust-extractor. This comprises a portable chamber built on an angle-iron frame, braced with tie-rods and bolts, and having a wooden top and base. The

(Concluded on page 607.)


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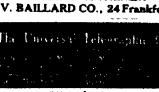
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whole is moved on wheels after the style of a bogie, and contains the exhaust fan and dust-bag. When stripping, the fan is operated by bands running from the carding-machine to grooved pulleys on the ends of the fan-shaft, these pulleys availing for right- or left-hand cards. The stripping of a card having been completed, the brush and casing are placed in brackets on the top of the chamber, and the next card is similarly treated.

Most of these dust-extractors perform another important function. They may be used as ventilators of rooms generally, apart from the removal of dust from carding-engines. The stripping process is performed four times each day, and occupies 40 to 60 minutes. In the intervals between these operations any of the apertures of the dust-extractors may be opened in any part of the room. Impure air may thus be drawn from twenty or more localities at the same moment by moderate exhaust currents, and without draughts playing on the workers. The improved condition of the air from the use of these widely-distributed exits will be readily appreciated.

With the installation of dust-extractors in the card-rooms of cotton mills, the health and working efficiency of the operatives concerned will be considerably improved. Likewise the material produced, in the shape of finished yarn, being free from specks of dust, will be very materially enhanced in its market value.

Telephones in Great Britain

ON December 31st, 1911, the telephone service of the United Kingdom will become, like the telegraph service of that country, a government monopoly.

The history of British telephones is reviewed in a recent report of Consul Rufus Fleming, stationed at Edinburgh. An act of 1869 gave to the Postmaster General the monopoly of operating telegraphs, and in 1890, as a result of the case of the Attorney General vs. the Edison Telephone Company, it was decided that telephones were included in the provisions of this act. However, the government, instead of buying up the patents and taking the telephone service into its own hands, granted licenses to the existing telephone companies. At first the companies were restricted in their operations to limited areas, but from 1884 onward the licenses were applicable over the entire kingdom. This led to the organization of large companies, and by 1892 practically all the business was in the hands of the National Telephone Company, Ltd. In 1896 the government took over the operation of all the trunk lines connecting one town with another, paying the company upwards of $2,333,725. The latter has since continued to operate the local lines, but will transfer all its business to the postoffice at the end of the present year.

There are approximately 644,000 telephones in the United Kingdom, but it is estimated that if the system were used in the same ratio to population as in the United States, the number would be nearly 3,000,000. Judging from the history of the telegraph service, it is expected that the transfer of the telephones to the government will result in a great extension of the system.

A Fiber Exposition in Java

A UNIQUE exhibit of fiber plants and fiber-working machinery has been held at Soerabaya, Java, during the past summer, in connection with the Fiber Congress of the East Indies, which opened July 3rd. Dutch, German, and British machinery was represented, made by Krupp, Benisch, Berand Liebescher, Lees & Co., and Oldham. All the fiber plants of Java, and many from the Philippines, Siam, etc., including sisal, agil, pineapple fiber, banana fiber, coconut fiber, Java cotton, kapok, and others, were exhibited. One exhibit showed the natives of Java working kapok and cotton from the very first stage of preparing the fiber to the finishing of the woven cloth.

Kapok is the silky fiber surrounding the seeds of the silk-cotton tree (*Ceiba pentandra*), one of the noblest trees of the tropics. It is extensively used in stuffing mattresses, and also in filling life-preservers, for which latter use it is especially valuable, as it will support a greater weight in water than any other substance used for this purpose. A mass of pressed kapok will support thirty-six or thirty-seven times its weight.

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